SUPPLEMENT TO

Beneath Apple ProDOS

For ProDOS 8, Versions 1.2 and 1.3

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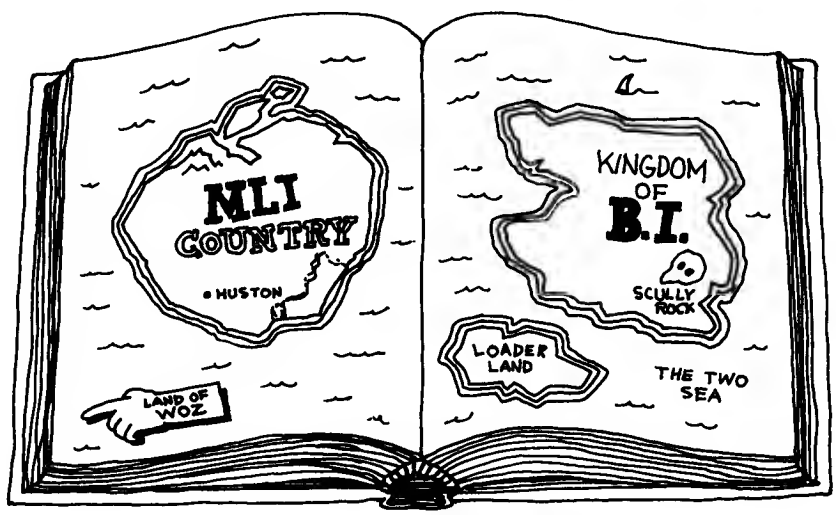


A Pro DOS ATLAS

INTRODUCTION

This supplement documents the actual ProDOS 8 logic at nearly a byte by byte level. It is intended to aid experienced programmers in designing customized interfaces to ProDOS 8, and to provide implicit documentation of the ProDOS 8 functions. All assembly language programmers will find this supplement useful in learning about how an operating system works. This information is presented in the spirit of helping the user to understand ProDOS 8 better. The authors do not endorse indiscriminant modification of the ProDOS components. Whenever possible, standardized interfaces to ProDOS should be used to avoid the uncontrolled modifications which plagued Apple's previous operating system, DOS 3.3.

External system programs and utilities such as the Apple II System Utilities are not covered here, nor are disk controller ROM's covered other than the Disk II controllers available from Apple.

The information presented here is for the release of the ProDOS operating system called ProDOS 8, Versions 1.2 and 1.3. Previous supplements to Beneath Apple ProDOS documented the structure of Versions 1.0.1, 1.0.2, and 1.1.1 of ProDOS.

UNDERSTANDING THE LISTINGS

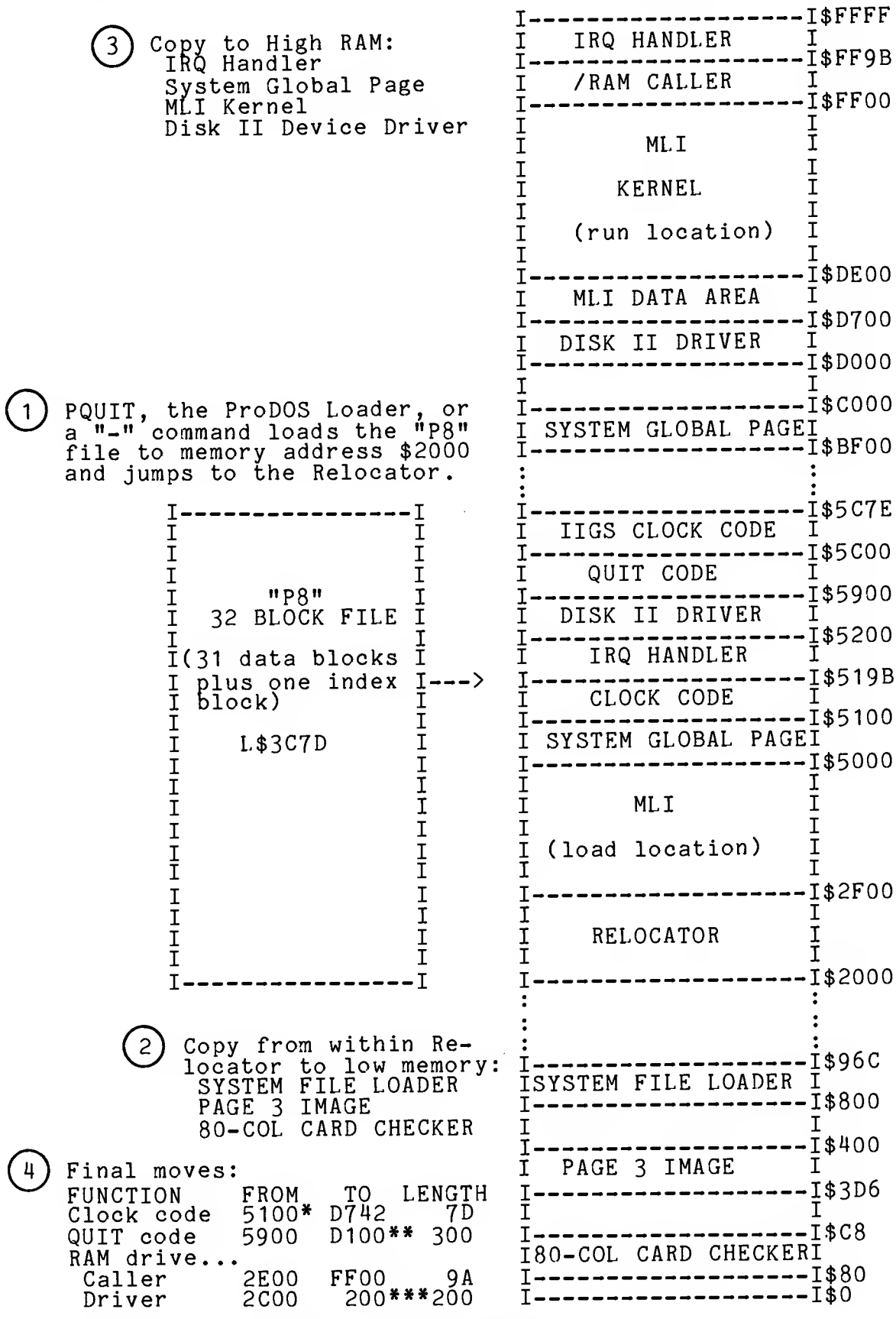
The listings which follow describe the major ProDOS 8 components in great detail. Each module is presented separately and consists of a section defining external addresses referenced by the program (such as zero page usage, I/O select addresses, and global page fields) followed by a section describing the instructions and data in the module. Divisions between major sections and subroutines are indicated with a row of asterisks (*) and additional comments.

Each detail line gives the address of the instruction or data field being described, followed by comments. Within the comments, the following notation is used to indicate references by instructions:

(address)	A store or load reference to a memory or I/O location.
>>address	A branch or jump to an address.
<address>	A call to a subroutine at the indicated address.
-->address	A pointer to an address.

Page titles give the address of the next instruction or data area in the module to be described. These may be used to quickly locate a particular area within the component.

HOW PRODOS 8 Versions 1.2 and 1.3 ARE LOADED AND RELOCATED



*5C00 if IIGS **BANK2 ***AUX MEMORY

```
ProDOS Loader -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: 0800
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

0800    MODULE STARTING ADDRESS
          ****************************************
          *                                      *
          *  PRODOS LOADER                       *
          *    THIS CODE IS LOADED FROM BLOCK 0  *
          *  INTO MEMORY AT $800.                *
          *  ITS PURPOSE IS TQ LOAD THE "PRODOS" *
          *  FILE INTO $2000 AND JUMP TO IT.     *
          *  (PRODOS RELOCATOR IS AT $2000)      *
          *                                      *
          *  VERSION 1.2 -- 6 SEP 86             *
          *  VERSION 1.3 -- 2 DEC 86             *
          *  (THE LOADER IS STILL THE SAME AS IT *
          *   WAS IN VERSION 1.0.1)              *
          *                                      *
          ****************************************

          *** EXTERNAL ADDRESSES ***

0027    ROM BOOT SUBRTN BUFFER PAGE ADDR
002B    ROM BOOT SUBRTN SLOT * 16
003D    ROM BOOT SUBRTN SECTOR TO READ
0040    ROM BOOT SUBRTN CURRENT TRACK
0041    ROM BOOT SUBRTN TRACK TO READ
          -- BLOCK READ PARAMETER LIST --
0042    COMMAND NUMBER (1 = READ)
0043    SLOT * 16
0044    I/O BUFFER ADDRESS ($44/$45)
0045
0046    BLOCK TO READ ($46/$47)
0047
          -------------------------------
0048    POINTER TO BLOCK READ ROUTINE
0049
004A    VOL DIR ENTRY POINTER/FIRST INDEX PAGE
004B
004C    ADDR OF SECOND PAGE OF INDEX BLOCK
004D
004E    INDEX INTO INDEX BLOCK PAGES
0050    TRACK SEEK PHASE-ON INDEX
0051    TRACK PHASE WANTED
0052    BLOCK READER RETRY COUNT
0053    CURRENT TRACK PHASE/PHASE-OFF INDEX
0054
0060    BUFFER POINTER
0061
05AE    SCREEN CENTER LINE
2000    LOAD POINT FOR RELOCATOR
C080    DISK ARM PHASE0
C088    TURN DISK DRIVE OFF
C089    TURN DISK DRIVE ON
```

```
ProDOS Loader -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: 0800
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

C08C     SHIFT DATA REGISTER
FC58     HOME CURSOR/CLEAR SCREEN

          **************************

0800    SIGNATURE BYTE ($01 MEANS BOOT ROUTINE FOLLOWS)
        (A $03 IS STORED HERE DURING A 5.25" FLOPPY BOOT)
              --  APPLE /// BOOTING --
          THIS CODE (BLOCK 0) IS LOADED AT $A000 WHEN
          BOOTED ON AN APPLE ///.  THE APPLE /// BOOT
          ROM JUMPS TO $A000.  WHAT IS SHOWN HERE AS
          $800 ON AN APPLE II IS $A000 ON AN APPLE ///.
          THUS AN APPLE /// EXECUTES A HARMLESS
          INSTRUCTION (ORA $38,X), THEN DOES NOT BRANCH
          ON CARRY, AND JUMPS TO $A132 ($932 ON AN
          APPLE II).  MANY THANKS TO DAV HOLLE FOR
          PROVIDING US WITH THIS APPLE /// INFORMATION.

0801 *********** MAIN ENTRY ****************************************
              ON ENTRY, X = SLOT*16
                        A = SECTOR NUMBER

  0801  ENTRY POINT FOR APPLE II
  0802  ALWAYS TAKEN (APPLE II) >>0807
  0804  JUMP TO APPLE /// LOGIC  >>A132
  0807  SAVE SLOT*16
  0809  READING SECTOR 3 NEXT?
  080B  REMEMBER THIS...
  080D  MAKE $CX FROM SLOT*16
  0815  AND SAVE AT $49
  0819  $48/49 --> $CXFF IN ROM BOOT
  081C  CHECK $CXFF
  081D  BOOT ROM FOR DISK II?
  081F  NO, NOT A 5.25" FLOPPY >>085B
  0821  GOT BOTH SECTORS OF LOADER? >>0831
  0823  NO, STOP AT SECTOR 3
  0825  STORE ON PARM (0800)
  0828  SKIP SECTOR 1 (GET SEC 2)
  082A  DUMMY UP $CX5C AS RETURN ADDRESS
  0830  AND CALL ROM SECTOR READ SUBRTN

          ******** LOAD PRODOS ********************
          (ENTIRE LOADER IN MEMORY NOW)

  0831  CURRENT TRACK IS ZERO
  0833  $48/49 --> $CX00
  0837  COPY A PORTION OF DISKETTE BOOT ROM
  0839  TO MY BLOCK READER SUBROUTINE (0994)
  083D  FROM $9F7 TO $A7E
  0843  MODIFY SOME BRANCHES IN THE COPIED CODE (091D)
  0846  TO SUIT MY ERROR HANDLING TASTES (0924)
```

```
ProDOS Loader -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: 084C
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  084C  AND COPY SECTOR READ SUBROUTINE EXIT CODE (092B)
  084F  TO $A7F TO $A85 (0A7F)
  0855  $48/49 --> DISKETTE BLOCK READER SUBRTN
  0859  AT $0986
  085B  ---
  085D  LEGAL DISK ROM?
  085F  NO, ERROR >>0890
  0861  STORE LSB OF BLOCK READER
  0863  STORE ZEROS IN SEVERAL THINGS
  086E  COMMAND = 1 (READ BLOCK)
  087I  BLOCK NUMBER = 2 (VOL DIRECTORY)
  0875  $60/61 --> $C00 (BUFFER)
  0877  $4A/4B --> $C00 (FIRST ENTRY)
  0879  READ VOLUME DIRECTORY BLOCKS <09I2>
  087C  ERROR? >>08E6
  087E  MOVE UP TWO PAGES IN MEMORY
  0882  NEXT BLOCK NUMBER
  0886  NOW AT BLOCK 6?
  0888  NO, GO READ NEXT ONE >>0879
  088A  YES, CHECK LINK FOR VALIDITY (0C00)
  088D  IT SHOULD BE ZERO FOR VOL DIR (0C01)
  0890  BAD VOLUME DIR IF NOT ZERO >>08FF
  0892  NO, INDEX PAST LINK AND VOL HDR
  0894  AND BEGIN >>0898
  0896  IF ALREADY PROCESSING, USE ENTRY LSB
  0898  ---
  0899  ADD ENTRY LENGTH TO FIND NEXT ENTRY (0C23)
  089D  STILL IN SAME PAGE? >>08AC
  089F  NO, BUMP ENTRY MSB
  08A3  IS IT ODD? (SECOND PAGE OF A BLOCK?)
  08A4  YES... >>08AC
  08A6  NO, JUST FINISHED LAST BLOCK?
  08A8  YES, ERROR -- FILE NOT FOUND >>08FF
  08AA  ELSE, START JUST PAST LINKS
  08AC  UPDATE LSB OF ENTRY POINTER
  08AE  GET NAME LENGTH (0902)
  08BI  MASK OFF STORAGE TYPE
  08B4  COMPARE NAME WITH "PRODOS"
  08B9  NOT A MATCH?  >>0896
  08BE  IF NAME MATCHES, IS IT A SAPLING FILE?
  08C2  IF NOT, I CAN'T HANDLE IT >>08FF
  08C6  GET FILE TYPE
  08C8  SHOULD BE A PRODOS SYS FILE
  08CA  IF NOT, I GIVE UP >>08FF
  08CD  ALL IS WELL, COPY KEY BLOCK NUMBER
  08CF  TO $46/47
  08D6  $4A/4B AND $60/6I --> $1E00
  08D8  (BUFFER TO HOLD KEY BLOCK)
  08E1  $4C/4D --> $1F00 (SECOND PAGE)
  08E3  READ A BLOCK <0912>
  08E6  ERROR? >>08FF
```

```
ProDOS Loader -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: 08EA
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  08EA  BUMP TO NEXT BLOCK BUFFER
  08EE  $4E = OFFSET INTO INDEX BLOCK
  08F0  GET NEXT BLOCK NUMBER FROM INDEX BLOCK
  08F8  BLOCK NUMBER = 0? (END OF FILE)
  08FA  NOT YET, READ A BLOCK >>08E3
  08FC  ELSE, JUMP TO RELOCATOR AT $2000 >>2000

  08FF  ERROR JUMP >>093F

0902 *********** KERNEL NAME ****************************************

  0902  LENGTH OF KERNEL'S NAME
  0903  'PRODOS          ' "PRODOS" (KERNEL NAME)

09I2 *********** COPY BLOCK READ BUFFER PTR **************************

  0912  COPY $60/6I --> $44/45
  09I4  (BLOCK READ BUFFER POINTER)
  09IA  THEN GO TO BLOCK I/O ROUTINE >>0048

091D *********** ROM SECTOR READ OFFSETS ******************************
           OFFSETS INTO ROM SECTOR READ SUBROUTINE
           TO BRANCH DISPLACEMENTS WHICH NEED TO
           BE CHANGED FOR LOADER'S PURPOSES

  09ID

         ******** NEW BRANCH OFFSETS FOR ABOVE ***

  0924  ---

092B *********** SECTOR READ EXIT CODE ********************************
           COPIED TO END OF DISKETTE SECTOR READ CODE

  092B  GET SLOT*16
  092D  AND EXIT NORMALLY
  092E  RETURN
  092F  RESTART BLOCK READ OPERATION >>09BC

0932 *********** APPLE /// BOOT CODE **********************************

A132    THIS IS $A132 WHEN BOOTED ON APPLE ///
  0932  MAKE IT LOOK LIKE A JSR FROM $A000
  0938  LOAD IN BLOCK 1 (WE WANT SOS, NOT PRODOS)
  093C  GO TO APPLE /// BLOCK READ ROUTINE >>F479
```

```
ProDOS Loader -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: 093F
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

093F *********** ERROR HANDLER ***************************************

  093F  HOME CURSOR/CLEAR SCREEN <FC58>
  0944  COPY "UNABLE TO LOAD PRODOS" MESSAGE (0950)
  0947  TO SCREEN (05AE)
  094D  THEN GO TO SLEEP FOREVER >>094D

  0950  ---
  0950  '*** UNABLE TO LOAD PRODOS ***'

096D *********** MOVE ARM TO NEXT PHASE ******************************

  096D  GET CURRENT PHASE
  096F  CONVERT TO NEXT ARM PHASE
  0972  ADD SLOT*16
  0975  SELECT NEXT ARM PHASE THIS DRIVE (C080)
  097A  ---
  097C  DELAY LONG ENOUGH FOR ARM TO MOVE
  0983  WHEN FINISHED, RETURN WITH X = SLOT*16
  0985  RETURN

0986 *********** DISKETTE BLOCK READ ROUTINE *************************
          $44/$45 --> BUFFER
          $46/$47 = BLOCK NO.

  0986  GET BLOCK NO. LSB
  0988  ISOLATE SECTOR REMAINDER
  098C  SKEW SECTOR BY 2
  0992  AND STORE SECTOR WANTED
  0994  GET MSB
  0996  AND HIGH BIT OF TRACK
  0999  MERGE WITH LOW PART OF TRACK
  099C  STORE TRACK WANTED
  099F  TRACK*2 IS PHASE WANTED
  09A3  SET PAGE ADDRESS OF BUFFER
  09A7  TURN DRIVE MOTOR ON (C089)
  09AA  READ SECTOR <09BC>
  09AD  NEXT PAGE
  09B1  SKEW TO NEXT SECTOR
  09B5  READ SECOND SECTOR OF BLOCK <09BC>
  09B8  THEN TURN MOTOR OFF AND EXIT (C088)
  09BB  RETURN

          ******** DISKETTE SECTOR READ ROUTINE ***

  09BC  GET CURRENT TRACK
  09BF  CONVERT TO PHASE
  09C5  GET CURRENT PHASE
  09C7  STORE FOR PHASE OFF
  09CA  SUBTRACT PHASE WANTED TO DETERMINE...
  09CC  DIRECTION -- ON CORRECT TRACK NOW? >>09E2
```

```
ProDOS Loader -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: 09D0
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  09D0  NO, ADJUST PHASE UP...
  09D4  OR DOWN AND...
  09D6  ---
  09D7  SEEK ARM ONE PHASE... <096D>
  09DD  IN PROPER DIRECTION  <096F>
  09E0  UNTIL WE ARE THERE >>09C5
  09E2  ---
  09E4  RETRY COUNT OF 127
  09E7  ---
  09E9  LOWER RETRY COUNT
  09EB  RETRIES EXHAUSTED? >>09BB
  09EF  RETRIES FOR A $D5 HEADER
  09F2  CHECK DATA REGISTER (C08C)
  09F5  LOOP UNTIL DATA IS VALID >>09F2

          ******** SECTOR READ ROUTINES ***********

09F7    BEGINNING OF COPIED ROUTINES
        (SEE $C65E IN BOOT FIRMWARE DESCRIPTIONS)
        ($CX63-$CXEA IS COPIED TO $9F7-$A7E)

0A7F    EXIT CODE FOR READ ROUTINES
        (COPIED HERE FROM $92B-$930)

0A86 *********** $A86-$BFF NOT USED **********************************
  0A86  NOT USED

0C00 *********** VOLUME DIRECTORY BUFFER *****************************

0C00    START OF VOLUME DIRECTORY BUFFER
0C23    OFFSET TO ENTRY LENGTH FIELD
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2000
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

2000    MODULE STARTING ADDRESS

          *********************************
          *                               *
          *  PRODOS RELOCATOR             *
          *       LOADED AS THE FIRST     *
          *       PORTION OF THE PRODOS   *
          *       IMAGE AT $2000.         *
          *                               *
          *  VERSION 1.2 -- 6 SEP 86      *
          *                               *
          *********************************

          ******** ZERO PAGE ADDRESSES ************

000A    AUTOSTART ROM CHECKSUM POINTER
000B
000C    CONFIGURATION BYTE (MACHID TO BE)
0010    GENERAL PURPOSE POINTER
0011
0012    DISK TYPE (0=DISK II, 4=PROFILE)
0013     AND INPUT RELOC RANGE POINTER
0014    VOL DIR ENTRY POINTER FOR RELOCATOR
0015     AND OUTPUT RANGE PTR
0016    LENGTH OF RELOCATION RANGE
0017
0018    INPUT RELOCATION RANGE POINTER
0019
001A    END OF INPUT RANGE
001B
003C    GENERAL PURPOSE POINTER
003D
003E    GENERAL PURPOSE POINTER
003F
0040    RAMDRIVE OUTPUT POINTER
0041
0042    VARIOUS USES: PARM TO AUXMOVE,
0043     UNIT/SLOT PASSED TO RELOCATOR
0046    BLOCK NUMBER TO RAMDRIVE
0047

          ******** EXTERNAL ADDRESSES *************

0080    MACHID BUILD SUBRTN FOR 128K
0101    SAVE AUX STACK POINTER (IN AUX STACK)
0280    GENERAL PURPOSE BUFFER
0281    BUFFER+1
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2000
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

          ******** SCREEN LINE ADDRESSES **********

04B8    SCREEN BUFFER ROW 10
05A9    SCREEN BUFFER ROW 12
05AD    SCREEN BUFFER ROW 12
06B6    SCREEN BUFFER ROW 14
07A8    SCREEN BUFFER ROW 16
07AD    SCREEN BUFFER ROW 16
07D0    SCREEN BUFFER ROW 24

          ******** MISCELLANEOUS ADDRESSES *********

0800    ENTRY OF INTERP LOADER
0C00    VOLUME DIRECTORY BUFFER
0C23    ENTRY LENGTH
          -- RAMDRIVE VOLUME DIRECTORY --
0E04    VOLUME HDR, VOLUME NAME
0E22    VOLUME HDR, ACCESS-TOTAL BLOCKS
2000    START OF SYSTEM PROGRAMS
2C00    RAMDRIVE DEVICE DRIVER LOAD ADDRESS
2A00    DIFFERENCE OF RAMDRIVE LOAD AND RUN LOCATIONS
BFFF    TOP OF 48K RAM

          ******** SYSTEM GLOBAL PAGE *************

BF00    ENTRY POINT FOR MLI
BF03    QUIT VECTOR
BF06    DATE/TIME
BF10    DEVICE HANDLER TABLES
BF30    LAST DEVICE USED
BF31    NUMBER OF ACTIVE DISK DEVICES
BF32    ACTIVE DISKS SEARCH LIST
BF98    MACHINE TYPE FLAGS
BF99    SLOT WHICH CONTAIN CARDS WITH ROM
BFFF    MLI VERSION NUMBER

          ******** I/O PORT ADDRESSES *************

C000    80 STORE OFF
C001    80 STORE ON
C002    READ MAIN RAM
C003    READ AUX RAM
C004    WRITE MAIN RAM
C005    WRITE AUX RAM
C008    MAIN STACK/ZERO PAGE
C009    ALTERNATE STACK/ZERO PAGE
C00A    INTERNAL SLOT 3 ROM
C00B    PERIPHERAL SLOT 3 ROM
C00C    80 COLUMN DISPLAY OFF
C018    READ 80STORE SWITCH
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2000
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

C030    SPEAKER
C054    USE MAIN MEMORY PART OF 80-COL CARD
C055    USE AUX MEMORY PART OF 80-COL CARD
C068    IIGS STATEREG STATUS BYTE
C08I    WRITE-ENABLE HIGH RAM
C082    MOTHERBOARD ROM READ ENABLE
C083    READ/WRITE RAM 2ND 4K BANK
C08B    READ/WRITE RAM 1ST 4K BANK

        ******** INTERNAL C3ROM ADDRESSES *******

C31I    MOVE TO/FROM AUXMEM SUBROUTINE
C314    TRANSFER TO/FROM AUXMEM SUBROUTINE

        ******** SLOT ROM ADDRESSES *************

C305    SLOT3 I.D. BYTE
C307    SLOT3 I.D. BYTE
C30B    SLOT3 I.D. BYTE
C30C    SLOT3 I.D. BYTE
C3FA    SLOT3 I.D. BYTE
CFFF    RESET I/O CARD ROMS

        ******** PRODOS ADDRESSES ***************

D000    START OF QUITCODE MEMORY AREA (BANK2)
DFF1    ENHANCED ROM FLAG
FDB8    VERSION NUMBER (FOR SUBDIRECTORIES)
FEFF    GS VIDEO FLAG
FF00    RAMDRIVE CALLER ADDRESS

        ******** MONITOR ROM *********************

FBIE    PADDLE READ SUBROUTINE
FB2F    MONITOR INIT ROUTINE
FBB3    ROM VERSION BYTE
FBC0    SECONDARY VERSION BYTE (0-3)
FC58    CLEAR SCREEN
FE1F    THIS ROUTINE CHECKS FOR IIGS
FE84    SET NORMAL VIDEO
FE89    IN#0
FE93    PR#0

2000 *********** PRODOS RELOCATOR MAIN ENTRY *************************

  2000  JUMP OVER PQUIT ENTRY >>2006
  2003  SET FLAG INDICATING PQUIT ENTRY (IIGS) (2IDI)
  2006  STORE SLOT IN MLI ONLINE PARMS
  200B  PRINT "APPLE II PRODOS..." <25BI>
  200E  SET UP FOR COMMON MOVES (226E)
  20I4  RELOCATE SOME ROUTINES & DATA TO LOW MEMORY <28B0>
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2017
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2017  RELOCATION ERROR >>203C
  201D  BE SURE 48K OF MAIN MEMORY EXISTS (BFFF)
  2024  IF NOT, ERROR >>204E
  2029  MAKE DOUBLY SURE  (BFFF)
  202C  ERROR THIS TIME >>204E
  202E  SELECT MOTHERBOARD ROMS (C082)
  2031  DETERMINE MACHINE TYPE <25IF>
  2036  PICK UP CONFIGURATION BYTE
  2038  64K OR MORE MEMORY?
  203A  YES, WE HAVE 64K RAM >>203F
  203C  ERROR.  MUST HAVE 64K OR MORE!! >>2227

        ******** RELOCATE PRODOS ***************

  203F  SET UP FOR MLI MOVE (2270)
  2045  COPY/RELOCATE PRODOS ITSELF <28B0>
  2048  GET PRODOS VERSION NUMBER  (BFFF)
  204B  AND PUT IT IN MLI DATA AREA. (FDB8)
  204E  RELOCATION ERROR! >>20AC
  2050  ENABLE MOTHERBOARD ROMS AGAIN (C082)
  2053  CHECK ROM I.D. BYTE (FBB3)
  2056  APPLE //e FAMILY?
  2058  NO, LEAVE I.D. BYTE AS IS >>208E
  205C  TEST ANOTHER ROM I.D. BYTE (FBC0)
  205F  SAVE BIT TEST RESULTS
  2060  GET MACHID
  2062  STRIP BITS THAT IDENTIFY MODEL
  2067  IT'S A //e IF BITS 6 & 7 ARE HIGH >>2075
  2069  ---
  206A  EITHER A //c OR A FUTURE SYSTEM
  206C  CHECK HIGH BITS OF $FBC0 AGAIN
  206D  BIT 7 ON? >>2073
  206F  YES, FUTURE SYSTEM.
  2073  IF BIT 6 ON, IT'S A FUTURE SYSTEM. >>2077
  2075  ---
  2077  REPLACE UPDATED MACHID
  207D  LOOK AT ROM. THIS A IIGS? <FE1F>
  2080  NO, CARRY STILL SET. >>208E
  2082  YES, SET IIGS FLAG. (2278)
  2085  ENTER FROM PQUIT? (21DI)
  2088  YES, THIS IS NOT INITIAL BOOT. >>208E
         NOW SET OS_BOOT TO ZERO, INDICATING THAT PRODOS8
         WAS THE OPERATING SYSTEM INITIALLY BOOTED.
  208A  65816 INSTRUCTION: STA $EI00BD
  208E  COPY BOOT DEVICE ID TO READ BLOCK PARMS (2262)
  2094  AND AS LAST DEVICE USED (BF30)
  2097  DETERMINE PERIPHERAL CARD CONFIGURATION <265F>
  209A  BOOT DEVICE TO... (2269)
  209D  GLOBAL PAGE LAST DEVICE USED (BF30)
  20A0  ENABLE READ/WRITE HIGH RAM, BANK I <2518>
  20A9  COPY CLOCK CODE TO DEVICE DRIVER AREA <28B0>
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 20AC
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  20AC  ERROR? >>20DA
  20AE  CHECK MACHINE TYPE AGAIN (BF98)
  20B1  GOT 64K OR MORE?
  20B5  NO  >>20DD
  20B7  YES, QUIT VECTOR --> $FCA9
  20C1  WRITE TO HIGH RAM (BANK2) (C083)
  20CA  POINT TO QUIT CODE TABLE (2275)
  20CD  MOVE QUIT CODE TO HIGH RAM <28B0>
  20D2  STORE QUIT VECTOR START PAGE (D000)
  20D5  ENABLE READ/WRITE HIGH RAM, BANK 1 <2518>
  20DA  RELOCATION ERROR >>2227
  20DD  GET MACHID YET AGAIN (BF98)
  20E0  128K?
  20E4  NO... >>20FC
  20E6  YES, SET UP AUX RAM
  20E8  SAVE STATUS REG IN ACCUM
  20EA   DISABLE INTERRUPTS
  20EB  PREPARE TO WRITE TO AUX STACK AREA (C009)
  20EE  AUX STACK POINTER SET TO $FF (0101)
  20F1  BACK TO MAIN Z-PAGE, STACK (C008)
  20F4  RESTORE STATUS REG
  20F9  ESTABLISH RAM DRIVE IN AUX MEM <2B00>

          ******** SET UP FOR IRQ (ENHANCED ROM) **

  20FC  READ ROM (C081)
  20FF  GET ROM'S IRQ VECTOR (FFFE)
  2105  ENABLE READ/WRITE HIGH RAM, BANK 1 <2518>
  2108  CARRY CLEAR IF IRQ VECTOR IN C3 ROM
  210A  FLAG FOR "OLD ROM"
  210C  IT'S AN OLD ROM >>2127
  210E  SWITCH TO AUX STACK & HIGH RAM (C009)
  2113  INITIALIZE AUX STACK POINTER TO $FF (0101)
  2116  PUT IRQ VECTOR IN AUX HIGH RAM (FFFF)
  211C  BACK TO MAIN HIGH RAM & Z-PAGE (C008)
  211F  PUT IRQ VECTOR IN MAIN HIGH RAM (FFFF)
  2125  INDICATE ENHANCED IRQ LOGIC ON BOARD
  2127  STORE FLAG IN MLI DATA AREA (DFF1)

          ******** LOOK FOR SLOT 3 VIDEO CARD *****

  212A  ---
  212C  SET GS VIDEO FLAG=0 (FEFF)
  212F  THIS A IIGS? (2278)
  2132  NO. >>213A
  2134  YES, SET GS VIDEO FLAG (IN MLI) (FEFF)
  2137  AND DON'T BOTHER SEARCHING SLOT 3. >>21A5
  213A  ENABLE INTERNAL VIDEO FIRMWARE (C00A)
  213D  CHECK FOR ROM  (BF99)
  2140  IN SLOT 3.
  2142  ROM EXISTS. >>2147
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2144
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2144  NO ROM. >>21AD
  2147  LOOK AT THE SLOT 3 ROM (C00B)
  214A  AT OFFSET +$05 (C305)
  214D  THERE MUST BE A $38
  2151  AND AT OFFSET +$07 (C307)
  2154  THERE MUST BE AN $18
  2158  AND AT OFFSET +$0B (C30B)
  215B  THERE MUST BE A 1
  215F  AND AT OFFSET +$0C (C30C)
  2164  INDICATE AN 80-COL CARD.
  2168  CHECK MACHINE TYPE (BF98)
  216D  IS THIS AN APPLE III?
  216F  OK, IT'S GOT 80-COL CAPABILITY >>21A5
  2171  OTHER MANUFACTURERS MUST FOLLOW THE RULES! (C3FA)
  2174  MUST HAVE BIT INSTRUCTION AT $C3FA
  2176  GOOD BOY, YOU FOLLOWED THE RULES! >>21A5
  2178  GIVE CONTROL BACK TO MOTHERBOARD ROM (C00A)
  217B  TURN ON 80-COL (C001)
  217E  CHECK FOR AUX MEM. (C055)
  2183  PUT A BYTE AT AUX $400 (0400)
  2186  THE ACCUMULATOR LEFT
  2187  AND DO THE SAME WITH $400 (0400)
  218A  STILL THE SAME? (0400)
  218D  NO, NO 80-COL MEMORY >>2196
  218F  SHIFT TO THE RIGHT
  2193  STILL THE SAME? (0400)
  2196  BACK TO MAIN MEMORY (C054)
  2199  TURN OFF 80-COL (C000)
  219C  WAS 80-COL MEMORY FOUND? >>21A5
  219E  NO, SO TURN OFF 80-COL FLAG (BF98)
  21A1  IN MACHINE I.D. BYTE.
  21A3  ALWAYS BRANCH >>21AA
  21A5  TURN ON 80-COL FLAG (BF98)
  21AD  THIS A IIGS? (2278)
  21B0  NO. >>21C8
  21B2  YES, ENABLE IIGS CLOCK DRIVER
  21B7  GET ADDRESS OF RELOCATE TABLE (2276)
  21BA  FOR IIGS CLOCK CODE (2277)
  21BD  AND PUT THE CODE AT $D742 <28B0>
  21C0  INDICATE CLOCK EXISTS IN MACHID (BF98)
  21C8  ENTER FROM PQUIT? (21D1)
  21CB  NO. >>21D2
  21CD  YES, ENABLE ROM FOR READ (C082)
  21D0  RETURN

  21D1  PQUIT FLAG. (0 = PRODOS 8 WAS INITIAL BOOT)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 21D1
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

        ******** GET VOL LABEL ******************

 21D2  MLI: ONLINE DEVICE CALL <BF00>
 21D8  ERROR? >>2227
 21DD  VALID VOLUME NAME?
 21DF  IF NOT, ERROR >>2227
 21E2  ELSE, BUMP LENGTH BY ONE
 21E7  AND PREFIX NAME BY A "/"
 21EC  MLI: SET PREFIX <BF00>
 21F2  ERROR? >>2227

        ******** READ VOLUME DIRECTORY **********

 21F4  ---
 21F5  $14/15 --> $C00
 21FB  ---
 2200  BLOCK = 2 (VOLUME DIRECTORY) (226C)
 2206  MLI: READ BLOCK <BF00>
 220C  ERROR? >>2227
 2210  GET NEXT BLOCK NUMBER
 2216  IF ZERO, END OF VOLUME DIRECTORY >>2224
 221E  ADD TWO PAGES (ONE BLOCK) TO POINTER
 2220  AND STOP AT $1400 IN ANY CASE
 2222  ELSE, READ NEXT BLOCK AS WELL >>21FB
 2224  WHEN DONE, JUMP TO SYSTEM FILE LOADER >>0800

2227 *********** ERROR HANDLER ***************************************

 2227  ENABLE MOTHERBOARD ROMS (C082)
 222A  CLEAR SCREEN <FC58>
 222F  PRINT "RELOCATION/CONFIG ERROR" (223B)
 2238  THEN SLEEP FOREVER  >>2238

223B *********** DATA ************************************************

 223B  ---
 223B  '** RELOCATION / CONFIGURATION ERROR **'

 2261  MLI: ONLINE PARMS
 2262          SLOT*16 AND DRIVE
 2263          READ THEM TO $281

 2265  MLI: SET PREFIX PARMS
 2266          PREFIX IS AT $280

 2268  MLI: READ BLOCK PARMS
 2269          DEVICE
 226A          BUFFER
 226C          BLOCK NUMBER
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 226C
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

 226E  ADDRESS OF COMMON MOVES RELOC TABLE
 2270  ADDRESS OF PRODOS RELOC TABLE
 2272  ADDRESS OF THUNDERCLOCK DRIVER RELOC TABLE
 2274  ADDRESS OF QUIT CODE RELOC TABLE
 2276  ADDRESS OF IIGS CLOCK DRIVER RELOC TABLE

 2278  IIGS FLAG. IF NON-ZERO, THIS IS A IIGS.

2279 *********** RELOCATION TABLES ************************************
          +0:     00 - ZERO BLOCK OF MEMORY
                  01 - COPY BLOCK
                  02 - RELOCATE MSB ADDRESSES
                  03 - RELOCATE 2 BYTE ADDRS
                  04 - RELOCATE INSTRUCTIONS
          +1/2:   ADDR OF OUTPUT BLOCK
          +3/4:   LENGTH OF BLOCK IN BYTES
          +5/6:   ADDR OF INPUT BLOCK (IF ANY)
          +7:     NUM RANGES TO CORRECT FOR (-1)
          +8:             START PAGES
          +8+COUNT:       END PAGE ADDRESSES
          +8+COUNT+COUNT:ADDITIVE CORRECTION FACTOR

          ******** COMMON MOVES TABLE *************

 2279  COPY (SYSTEM FILE LOADER)
 227A          TO =$800
 227C          LEN=$213
 227E          FRM=$22DB
 2280  COPY (PAGE 3 IMAGE)
 2281          TO =$3D6
 2283          LEN=$2A
 2285          FRM=$24EE
 2287  COPY (CHECKSUM)
 2288          TO =$0A
 228A          LEN=$02
 228C          FRM=$14
 228E  COPY (CHECK FOR 80-COL CARD)
 228F          TO =$80
 2291          LEN=$46
 2293          FRM=$256B
 2295  END OF TABLE

        ******** QUIT CODE MOVE TABLE ***********

 2296  COPY (QUIT CODE)
 2297          TO =$D100
 2299          LEN=$300
 229B          FRM=$5900
 229D  END OF TABLE
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 229D
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

        ******** PRODOS RELOC TABLE *************

  229E  COPY (IRQ HANDLER)
  229F          TO =$FF9B
  22A1          LEN=$65
  22A3          FRM=$519B
  22A5  COPY (SYSTEM GLOBAL PAGE)
  22A6          TO =$BF00
  22A8          LEN=$100
  22AA          FRM=$5000
  22AC  ZERO (PRODOS KERNEL DATA AREA)
  22AD          ADR=$D700
  22AF          LEN=$700
  22B1  COPY (PRODOS KERNEL)
  22B2          TO =$DE00
  22B4          LEN=$2100
  22B6          FRM=$2F00
  22B8  COPY (DISKETTE DRIVER)
  22B9          TO =$D000
  22BB          LEN=$700
  22BD          FRM=$5200
  22BF  END OF TABLE

        ******** THUNDERCLOCK TABLE *************

  22C0  COPY (THUNDERCLOCK CODE)
  22C1          TO =$D742
  22C3          LEN=$7D
  22C5          FRM=$5100
  22C7  RELOCATE INSTRUCTIONS
  22C8          TO =$D742
  22CA          LEN=$69
  22CC          FRM=$D742
  22CE          FOR ADDRS=$C1XX-$C1XX
  22D1          ADJUST BY=$S0
  22D2  END OF TABLE

        ******** IIGS CLOCK TABLE *************

  22D3  COPY (IIGS CLOCK CODE)
  22D4          TO =$D742
  22D6          LEN=$7D
  22D8          FRM=$5C00
  22DA  END OF TABLE
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 22DB
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

22DB ******** SYSTEM FILE LOADER ************************************
           (COPIED TO AND RUN AT $800)

  22DB  MLI: GET.FILE.INFO CALL <BF00>
  22DF  FIRST SEE IF THERE IS AN A "ATINT" FILE
  22E1  NO ERRORS >>22EA
  22E3  IS ERROR "FILE NOT FOUND"?
  22E5  YES, THAT'S OK. >>232C
  22E7  NO, OTHER ERROR >>232F

  22EA  GET FILE TYPE OF FILE FOUND (088D)
  22ED  IS IT "ATINIT" FILE?
  22EF  NO, ERROR >>232F
  22F1  MLI: OPEN CALL <BF00>
  22F7  FILE DOESN'T OPEN >>232F
  22F9  MLI: GET_EOF CALL <BF00>
  22FF  CAN'T FIND EOF >>232F
  2301  HIGH BYTE OF EOF (0A01)
  2304  FILE TOO BIG >>232F
  2306  MEDIUM BYTE OF EOF (0A00)
  2309  MAX FILE SIZE IS $9800
  230B  FILE TOO BIG >>232F
  230D  PUT IN READ PARMS (0A07)
  2310  GET LOW BYTE OF EOF (09FF)
  2313  PUT IN READ PARMS (0A06)
  2316  MLI: READ CALL <BF00>
  231C  READ ERROR >>232F
  231E  MLI: CLOSE CALL <BF00>
  2324  CLOSE ERROR >>232F
  2326  READ ROM (C082)
  2329  GO TO APPLICATION <2000>

  232C  NOW LOOK FOR SYSTEM FILE >>08A8

  232F  PRINT ERROR MESSAGE: (233D)
  2332  "UNABLE TO LOAD ATINIT FILE" (233D)
  233B  SLEEP FOREVER >>233B

  233D  MSG LENGTH
  233E  "**     UNABLE TO LOAD ATINIT FILE     **"

  2364  GET_FILE_INFO PARMS (FOR ATINIT FILE)
        (LOCATED AT $889 WHEN EXECUTED)
  2365  PATHNAME ADDRESS
  2368  FILE TYPE

  2376  OPEN PARMS FOR ATINT FILE
         (AT $89B WHEN EXECUTED)
  2377  PATHNAME ADDRESS
  2379  I/O BUFFER AT $1400
  237B  REFNUM=1
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 237B
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  237C  ---
  237D  "ATINIT"

2383 ******** LOOK FOR NORMAL SYSTEM FILE ****************************
        (THIS CODE EXECUTES AT $8A8)

  2383  $10/11 --> VOLUME DIRECTORY ENTRIES
  2385  INITIALLY AT $C00
  2387  OFFSET BEYOND LINKS (+4)
  2389  JUMP OVER NEXT INSTRUCTION >>238D

          ******** SCAN DIRECTORY FOR SYSTEM FILE *

  238B  PICK UP LSB
  238D  ---
  238E  BUMP BY ENTRY LENGTH (0C23)
  2391  UPDATE LSB
  2393  PAGE OVERFLOW? >>23A7
  2395  NO, ROOM FOR ONE MORE ENTRY? (0C23)
  239A  NO, CHECK MSB
  239D  START OF A BLOCK? >>23A9
  239F  NO, AT END OF DIRECTORY?
  23A1  YES, FILE NOT FOUND IN DIRECTORY >>23C1
  23A3  NO, START NEW BLOCK AT +4
  23A5  AND UPDATE LSB
  23A7  BUMP MSB
  23A9  ---
  23AD  "SYSTEM" FILE TYPE?
  23AF  NO, TRY ANOTHER. >>238B
  23B2  INACTIVE ENTRY?
  23B4  IF SO, SKIP IT >>238B
  23B8  SAVE NAME LENGTH AT $280 (0280)
  23BD  MUST BE AT LEAST 8 CHARS LONG >>238B
  23BF  JUMP AROUND ERROR CODE >>23C3
  23C1  ERROR - SYSTEM FILE NOT FOUND >>2430

  23C3  ---
  23C6  IS THIS ".SYSTEM"?
  23C8  (SEE $24E7) (0A0C)
  23CC  NO, SKIP ENTRY >>238B
  23D0  CHECK ALL CHARACTERS IN NAME >>23C6

          ******** LOAD SYSTEM FILE AT $2000 ******

  23D2  ---
  23D4  ---
  23D5  COPY NAME TO $281
  23DC  AND TO "UNABLE TO LOAD" MSG (09E2)
  23E4  ADD BLANK AT END OF NAME
  23E6  IN MESSAGE (09E3)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 23EA
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  23EA  NAMELEN + ERRORMSGLEN
  23EC  SAVE AT $24D1 (09F6)
  23EF  MLI: OPEN .SYSTEM FILE <BF00>
  23F5  OPEN ERROR >>243D
  23F7  MLI: GET_EOF <BF00>
  23FD  CAN'T GET EOF >>243D
  23FF  GET HIGH BYTE (0A01)
  2402  FILE TOO BIG! >>2457
  2404  GET MEDIUM BYTE (0A00)
  2407  MUST BE LESS THAN $9800 BYTES
  2409  TOO BIG. >>2457
  240B  STORE LENGTH IN MLI READ PARMS (0A07)
  240E  GET LOW BYTE (09FF)
  2411  AND STORE IN READ PARMS. (0A06)
  2414  MLI: READ SYSTEM FILE INTO $2000 <BF00>
  241A  NO READ ERRORS >>2422
  241C  ERROR, BAD BUFFER?
  241E  YES, FILE WAS TOO LARGE >>2457
  2420  ELSE, "UNABLE TO LOAD ..." >>243D
  2422  MLI: CLOSE SYSTEM FILE  <BF00>
  2428  CLOSE ERROR >>243D
  242A  ENABLE MOTHERBOARD ROM (C082)
  242D  AND JUMP TO BEGINNING OF FILE >>2000

2430 *********** ERROR HANDLERS ***************************************

  2430  ---
  2432  PRINT "UNABLE TO FIND A .SYSTEM FILE" (0989)
  243B  THEN GO TO SLEEP >>2462

  243D  GET NAME LENGTH (09F6)
  2440  LINE LENGTH
  2443  LESS NAME LENGTH (09F6)
  2446  DIVIDED BY 2
  2447  GIVES OFFSET TO CENTER THE LINE (09F6)
  244B  PRINT "UNABLE TO LOAD ..." (09D1)
  2455  GO TO SLEEP FOREVER >>2462

  2457  ---
  2459  PRINT "SYSTEM PROGRAM TOO LARGE" (09B1)
  2462  GO TO SLEEP FOREVER >>2462

2464 *********** DATA AREA ********************************************

  2464  '**  UNABLE TO FIND A ".SYSTEM" FILE  ** '
  248C  '**  SYSTEM PROGRAM TOO LARGE  **'
  24AC  '** UNABLE TO LOAD X.SYSTEM **********'
  24D1  NAME LEN +13H (LEN OF MSG)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 24D1
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  24D2  MLI: OPEN PARM LIST (AT $9F7 WHEN EXECUTING)
  24D3  PATHNAME IS AT $280
  24D5  I/O BUFFER AT $1400
  24D7  REFNUM=1

  24D8  MLI: GET EOF PARM LIST (AT $9FD)
  24D9  REFNUM=1
  24DA  EOF MARK POSITION

  24DD  MLI: READ LIST (AT $A02)
  24DE  REFNUM=1
  24DF  READ INTO $2000
  24E1  LENGTH (FROM EOF MARK)
  24E3  ACTUAL LENGTH READ

  24E5  MLI: CLOSE LIST (AT $A0A)
  24E6  REFNUM=0, CLOSE ALL FILES

  24E7  '.SYSTEM'

24EE ********** END OF SYSTEM FILE LOADER **************************

24EE ********** PAGE 3 VECTOR IMAGE *********************************
                    ($3D6-$3FF)
          (INCLUDES A ROUTINE AT $3D6 THAT IS USED
           TO CALL A DEVICE DRIVER IN AUX HIGH RAM)

  24EE  FROM MAIN Z-PAGE, (C008)
  24F1  GET X+1 VALUES STARTING AT $42
  24F3  AND PUT IN AUX Z-PAGE (C009)
  24F6  AT SAME LOCATION.
           THE NEXT THREE BYTES (AT $3E3) ARE PATCHED
           WITH A JUMP TO A DEVICE DRIVER IN AUX
           HIGH RAM WHEN THE DRIVER IS INSTALLED.
  24FB  "NO DEVICE CONNECTED" ERROR (IF NOT INSTALLED)
  24FE  BACK TO MAIN Z-PAGE (C008)
  2501  RETURN
  2502  ADDRESS OF MLI ROUTINE THAT CALLS
         THE RAM-BASED DEVICE DRIVER.  THIS
         ADDRESS IS USED AS THE INSTALLED
         DRIVER'S ADDRESS IN THE GLOBAL PAGE.
  2508  BRK HANDLER AT $FA59
  250A  RESET AT $FF59
  250C  POWER UP BYTE
  250D  & VECTOR TO $FF59 >>FF59
  2510  CTL-Y VECTOR TO $FF59  >>FF59
  2513  NMI VECTOR TO $FF59 >>FF59
  2516  IRQ HANDLER AT $BFEB (GLOBAL PAGE)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2518
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

2518 ******** SET HIGH RAM FOR READ/WRITE ***************************

  2518  TWO READS OF $C08B (C08B)
  251E  RETURN

251F *********** DETERMINE MACHINE ID *******************************
                 $0C=00.. 0... APPLE II
                      01.. 0... APPLE II+
                      10.. 0... APPLE IIe or IIGS
                      10.. 1... APPLE IIc
                      11.. 0... APPLE /// EMULAT.
                      ..01 .... 48K RAM
                      ..10 .... 64K RAM
                      ..11 .... 128K RAM
                      .... ..1. 80 COL CARD
                      .... ...1 COMPATIBLE CLOCK

  251F  ASSUME NOTHING AT FIRST
  2523  GET A ROM BYTE (FBB3)
  2526  APPLE II?
  2528  YES, SET BIT >>254B
  252A  NO,
  252C  APPLE IIE OR IIGS?
  252E  YES, SET BIT >>254B
  2530  NO,
  2532  APPLE II+?
  2534  NO, STRANGE ROM! >>2545
  2539  REALLY A II+?
  253B  YES >>254B
  253F  /// EMULATION MODE?
  2543  ---
  2544  RETURN
  2545  OTHERWISE, UNKNOWN MACHINE
  2547  CREATE INVALID INSTR AT $80
  2549  AND GO THERE >>2568
  254B  UPDATE MACHID
  254D  READ/WRITE ENABLE HIGH RAM (BANK1) <2518>
  2552  SEE IF HIGH RAM EXISTS (D000)
  2564  IF PRESENT, MARK IN MACHID

256B *********** LOOK FOR AUXILIARY RAM ******************************
          (CODE MOVED TO $80 TO ALLOW BANK SWITCH)
          (ENTERED WITH MACHID IN ACCUMULATOR)

  256B  UPDATE MACHID
  256D  IF PLUS, IS II OR II+ >>25A4
  256F  IT'S A IIe OR LATER.  CHECK FOR 128K.
  2571  BANK TO AUX MEMORY (C005)
  2577  STORE A PATTERN AT $C00 (0C00)
  257A  AND AT $800 (0800)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2580
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2580  MAKE SURE PATTERN STAYS THERE
  2582  IT DIDN'T! >>2592
  2584  NOW SHIFT $C00 TO THE LEFT (0C00)
  2587  AND SHIFT THE ACCUM TO THE LEFT
  2588  ARE THEY STILL THE SAME? (0C00)
  258B  NO, AUX RAM NOT THERE. >>2592
  258D  DID $800 MOVE TOO? (0800)
  2590  NO, SO WE HAVE FULL 128K! >>2595
  2592   DON'T HAVE 128K
  2595  ---
  2596  BANK BACK TO MAIN MEMORY (C004)
  259C  ONLY 64K >>25A4
  25A0  NO, INDICATE 128K
  25A2  IN MACHID
  25A4  SET UP $A/B --> "APPLE II"
  25A6  IN MOTHERBOARD ROM AT $FB09
  25A9  $B NOW $FB
  25AB  SOMETHING WRONG >>25AF
  25AD  $A NOW $09
  25AF  ---
  25B0  RETURN TO CALLER

25B1 *********** DISPLAY LOAD MESSAGE *********************************

  25B1  CLICK SPEAKER (C030)
  25B4  STORE IN MAIN MEMORY  (C00C)
  25B7  80 COL DISPLAY OFF (C000)
  25BA  SET NORMAL VIDEO <FE84>
  25BD  CALL MONITOR INITIALIZATION <FB2F>
  25C0  SET VIDEO PR#0 <FE93>
  25C3  SET KEYBD IN#0 <FE89>
  25C6  OUT OF DECIMAL MODE
  25C7  CLEAR SCREEN <FC58>
  25CC  PRINT "APPLE //" (25FA)
  25D7  PRINT "PRODOS 8 " ETC. ON ROW 12 (2602)
  25E2  PRINT 12 BLANKS ON ROW 14 (2620)
  25ED  PRINT "COPYRIGHT" ETC. ON ROW 24 (262C)
  25F6  CLICK SPEAKER AGAIN (C030)
  25F9  DONE

25FA *********** DATA AREA ****************************************

  25FA  'APPLE //'
  2602  'PRODOS 8 V1.2        06-SEP-86'
  2620  '                    '
  262C  'COPYRIGHT APPLE COMPUTER, INC., 1983-86'
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2650
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2653  8 BYTES FOR SMARTPORT STATUS CALL
  265B  DRIVER ADDRESS
  265D  SPACES LEFT ON DEVICE LIST
  265E  SLOT 2 FLAG (0 = PRODOS STORAGE DEVICE IN SLOT 2)

265F *********** DETERMINE SLOT CONFIGURATION ************************

  265F  ---
  2661  ZERO SOME THINGS
  2668  DEVCNT=$FF (NO DEVICES YET) (BF31)
  266B  ALL 14 DEVICES ARE UNASSIGNED
  2670  FIRST CHECK SLOT 2
  2674  IS A STORAGE DEVICE IN SLOT 2? <2898>
  2677  IF NOT, SET A FLAG (265E)
  267A  NOW POINT TO SLOT 7
  267E  STORAGE DEVICE IN SLOT? <2898>
  2681  NO. >>26DF
  2683  GET $CSFF BYTE
  2685  LOOKS LIKE 16 SECTOR DISK II. >>26AC
  2687  LOOK LIKE 13 SECTOR DISK II?
  2689  YES, DON'T USE IT. >>26DF

          ***** NON-DISK II STORAGE DEVICE ********

  268B  CsFF BYTE = LOW BYTE OF DEVICE ADDRESS (265B)
  268E  CHECK BYTE AT OFFSET 7
  2690  TO SEE IF IT'S A SMARTPORT
  2692  NOT A SMARTPORT INTERFACE >>2697
  2694  GO DO SMARTPORT STUFF >>2844
  2697  ---
  2699  GET $CSFE (STATUS BYTE)
  269B  CAN WE AT LEAST READ STATUS AND DATA?
  269F  ANTICIPATE FAILURE
  26A0  CAN'T READ IT. NO SENSE USING IT. >>26DF
  26A2  PUT LEFT NIBBLE OF STATUS BYTE IN $12 <288D>
  26A6  PUSH CLC, INDICATING ONE DRIVE
  26A7  CARRY SET IF 2 OR 4 DRIVES
  26A8  GET HIGH BYTE OF SLOT ROM
  26AA  ALWAYS BRANCH INTO DISK II PROCESSING >>26B9

          ***** LOOKS LIKE A DISK II **************

  26AC  $12 = 0 FOR DISK II
  26AF  PUSH SEC ON STACK (DISK II HAS 2 DRIVES)
  26B0  GET LOW BYTE OF DISK II DRIVER ($00) (27D8)
  26B3  SAVE IT IN RELOC DATA AREA (265B)
  26B6  GET HIGH BYTE OF DISK II DRIVER ($D0) (27D9)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 26B6
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

        ***** COMMON PROCESSING ***************

 26B9   SAVE DEVICE ADDRESS HIGH BYTE (265C)
 26BC   ESTABLISH DEVICE DRIVER IN GLOBAL PAGE <2814>
 26BF   ONLY ONE DRIVE?
 26C0   YES, GO TO NEXT SLOT >>26DE
        IF TWO DRIVES WERE ASSIGNED, MOVE THEM TO
        THE BOTTOM OF THE LIST IN REVERSE ORDER
 26DE   ---
        CARRY IS NOW CLEAR IF A PRODOS STORAGE DEVICE
        WAS FOUND IN THIS SLOT.  OTHERWISE, CARRY IS SET.
 26DF   GO MARK SLTBYT TO SHOW ROMS IN SLOT <2768>
 26E2   MOVE DOWN ONE SLOT
 26E8   WE'VE DONE ALL SLOTS >>26ED
 26EA   CHECK NEXT SLOT >>267E
 26F3   STASHED ANY DEVICES AT BOTTOM OF LIST? (265D)
 26F6   NO. >>271A
 26F8   YES, MOVE THEM BACK
 2700   IN REVERSE ORDER.
 2715   DONE WHEN X=Y (265D)
 271A   ---
 271C   START AT BOTTOM OF SEARCH LIST (BF31)
 271F   GET A DEVICE FROM LIST (BF32)
 2722   PUT IT ON THE STACK
 2725   IS IT THE CURRENT SLOT? (BF30)
 2729   NO, KEEP LOOKING >>272D
 272B   YES, TAKE IT OFF THE STACK
 272C   INDICATE CURRENT SLOT FOUND
 272D   ---
 272E   MORE TO CHECK >>271F
 2730   GET DEVICE COUNT (BF31)
 2734   CURRENT SLOT NOT FOUND! >>274A
 2736   PUT CURRENT DRIVE AT (BF30)
 2739   BOTTOM OF SEARCH LIST (BF32)
 273D   ONLY ONE DEVICE ON LIST >>2751
 2740   ONLY ONE DRIVE ON BOOT SLOT >>274A
 2742   CHANGE DRIVE NUMBER
 2744   STORE OTHER DRIVE NEXT TO LAST (BF32)
 2748   CURRENT SLOT ONLY SLOT ON LINE >>2751
 274A   GET OTHER DEVICES
 274B   MOVE THEM AHEAD OF CURRENT DRIVE (BF32)
 274F   STILL MORE TO DO  >>274A

 2751   DO CHECKSUM ON ROM <27EA>
 2754   DOESN'T SAY "APPLE II"! >>275A
 2756   WE'RE HAPPY, STORE FINISHED MACHID (BF98)
 2759   AND LEAVE
 275A   UNKNOWN MACHINE, SO DIE HORRIBLY! >>2545
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 275A
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

275D ******** PUT A DEVICE ON DEVICE LIST ***************************

 275D   COMBINE DSSS with IIII
 2762   BUMP DEVICE COUNT BY ONE
 2763   AND ADD DRIVE TO SYSTEM SEARCH LIST (BF32)
 2766   ROLL LEFT ANTICIPATING ROLL RIGHT
 2767   RETURN

2768 *********** IDENTIFY I/O CARD ***********************************

 2768   WE ALREADY FOUND ROM IN THIS SLOT >>27C9
 276C   CHECK SIGNATURE ON CARD FOR THUNDERCLOCK
 2771   NOT IT >>278D
 2777   THUNDERCLOCK, WHICH SLOT?
 2779   SAVE SLOT NUMBER (LESS 1)
 277B   IN CLOCK CODE RELOCATION TABLE (22D1)
 2780   ENABLE CLOCK/CALENDAR JUMP IN GLOBALS (BF06)
 2785   NO MACHID! >>2751
 2787   INDICATE THAT A CLOCK IS PRESENT
 2789   AND UPDATE MACHID
 278B   GO MARK ROM IN THIS SLOT >>27C9
        CHECK FOR PASCAL 1.1 PROTOCOL
 278D   ---
 2791   $Cs05 = $38?
 2793   DOESN'T GET TO FIRST BASE >>27B8
 2799   $Cs07 = $18?
 279B   NO. >>27B8
 27A1   $Cs0B = $01?
 27A3   NO, BAD SIGNATURE >>27B8
 27A8   YES, GET LEFT NIBBLE
 27AA   80 COLUMN CARD?
 27AC   NO, UNKNOWN CARD >>27B8
 27B0   NO MACHID! >>2751
 27B2   MARK 80 COLUMN CARD PRESENT
 27B4   AND UPDATE MACHID
 27B6   GO MARK ROM IN THIS SLOT >>27C9

 27B8   UNKNOWN CARD, CHECK ROM TO
 27BC   SEE IF IT WILL HOLD A VALUE
 27C2   FOR SOME TIME.

 27C9   WE FOUND ROM IN THIS SLOT
 27CB   CONVERT SLOT NUMBER
 27CE   TO A BIT POSITION (27E2)
 27D1   AND OR INTO SLTBYT (BF99)
 27D7   RETURN TO CALLER
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 27D7
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

27D8 *********** DATA AREA *****************************************

  27D8  DISK II DEVICE DRIVER ENTRY POINT

  27DA  DEVICE SIGNATURE FOR:
  27DC  +0,+2,+4,+6 = THUNDERCLOCK
  27DE  +1,+3,+5,+7 = DISK
  27E0  (+7 NOT CHECKED)

  27E2  BIT POSITION TABLE FOR SLOTS
  27E5   (ALSO USED IN CHECKSUM CALCS)

27EA *********** COMPUTE AUTOSTART ROM CHECKSUM **********************

  27EA  ---
  27EB  GET ZERO IN INDEX REGISTER (27E2)
  27EE  POINT TO $FB09 ("APPLE II" IN ROM)
  27F0  MAKE SURE UPPER CASE
  27F5  UPDATE CHECKSUM (27E2)
  27F8  PUT HIGH BIT IN CARRY (27E2)
  27FC  DO 8 BYTES IN ALL (27E5)
  2801  ACCUM = $08
  2805  ACCUM = $80
  2807  TURN ON HIGH BIT (27E2)
  280A  ADD A FUDGE FACTOR
  280C  OH NO! A CLONE! >>2811
  280E  PASSED THE TEST...RETURN WITH MACHID
  2810  RETURN
  2811  ELSE, RETURN WITH ZERO MACHID
  2813  RETURN

2814 ***DEVICE DRIVER IN GLOBAL PAGE *********************************

  2814  SAVE CARRY (NUMBER OF DRIVES)
  2815  GET HIGH BYTE OF SLOT ADDRESS
  2817  MAKE IT SLOT NUMBER
  2819  TIMES 2
  281A  USE LATER IN Y-REG
  281B  NOW GET SLOT*16 IN ACCUM
  281D  NOW HAVE 0SSS0000 (DRIVE 1)
  281E  PUT DEVICE ID ON DEVICE LIST <275D>
  2821  GET BACK CARRY (NUMBER OF DRIVES)
  2822  ROLL CARRY INTO ACCUM
  2823  ONLY ONE DRIVE. >>2829
  2825  TWO DRIVES. BUMP DEVICE COUNT
  2826  AND PUT SECOND DRIVE ON SEARCH LIST (BF32)
  2829  STORE FINAL DEVICE COUNT (BF31)
  282C  SHIFT DRIVE INDICATOR BACK TO CARRY
  282D  GET LOW BYTE OF DEVICE DRIVER ADDRESS (265B)
  2830  PUT IN GLOBAL PAGE FOR DRIVE 1 (BF10)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2833
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2833  ONLY ONE DRIVE >>2838
  2835  PUT IN GLOBAL PAGE FOR DRIVE 2 (BF20)
  2838  GET HIGH BYTE OF DEVICE DRIVER ADDRESS (265C)
  283B  PUT IN GLOBAL PAGE FOR DRIVE 1 (BF11)
  283E  ONLY ONE DRIVE >>2843
  2840  PUT IN GLOBAL PAGE FOR DRIVE 2 (BF21)
  2843  RETURN

2844 ******** HANDLE SMART PORT ***************************************

  2844  PUT LEFT NIBBLE OF STATUS BYTE IN $12 <288D>
  2847  GET HIGH BYTE OF SLOT ROM ADDRESS
  2849  STORE IT IN RELOC DATA AREA (265C)
  284C  GET PRODOS ENTRY, LOW BYTE (265B)
  2850  ADD THREE TO GET SMARTPORT ENTRY
  2852  POKE INTO SMARTPORT CALL (285C)
  2858  POKE THE HIGH BYTE, TOO. (285D)
  285B  SELF MODIFIED TO CALL THE SMARTPORT <0000>
  285E  WITH A STATUS COMMAND.
  285F  PARMLIST AT $28AB
  2861  GET NUMBER OF DEVICES ON LINE (2653)
  2864  NONE ON LINE! >>288A
  2866  INDICATE IF DRIVE 2 EXISTS.
  2868  PUT DRIVER ADDRESS IN GLOBAL PAGE <2814>
  286D  IS THIS SLOT 5?
  286F  NO. >>288A
  2871  SLOT 2 BEING USED BY STORAGE DEVICE? (265E)
  2874  YES, TWO DRIVES IS ALL YOU GET! >>288A
  2876  GET NUMBER OF DEVICES AGAIN (2653)
  2879  MORE THAN TWO DRIVES?
  287B  NO. >>288A
  287D  SET CARRY IF DRIVE 4 EXISTS.
  287F  PUT THEM IN SLOT 2
  2883  PUT DRIVER ADDRESS IN GLOBAL PAGE <2814>
  288A  GO PROCESS NEXT SLOT >>26DE

288D ******** CONVERT STATUS FOR ID BYTE ******************************

  288D  GET STATUS BYTE
  2891  SHIFT LEFT NIBBLE TO RIGHT NIBBLE
  2895  PUT IT IN $12
  2897  RETURN

2898 ******** CHECK FOR PRODOS STORAGE DEVICE ************************

  2898  RESET I/O CARD ROMS (CFFF)
  289D  CHECK 3 BYTES ON CONTROLLER ROM
  28A2  ANTICIPATE FAILURE
  28A3  NOT A PRODOS STORAGE DEVICE >>28AA
  28A9  SUCCESS--THIS IS A PRODOS STORAGE DEVICE.
  28AA  RETURN
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 28AA
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

28AB ******** COMMAND LIST FOR SMARTPORT CALL ************************

  28AB  3 PARAMETERS
  28AC  OVERALL STATUS CALL
  28AD  PUT STATUS DATA AT $2653
  28AF  STATUS CODE IS $00

28B0 *********** RELOCATION ROUTINE *********************************
           (X/Y REGS CONTAIN TABLE ADDR)

  28B0  SAVE PASSED TABLE ADDRESS
  28B4  ACCESS IIGS STATEREG BYTE TO (C068)
  28B7  TURN OFF SLOT ROM, ENSURE ROM BANK 0
  28BC  ---
  28BE  GET OPERATION CODE
  28C0  VALID OPERATION? (4 OR LESS)
  28C2  NO, ERROR >>2936
  28C6  $14/15 --> OUTPUT BLOCK
  28D0  $16/17 --> LENGTH
  28D9  NEGATIVE LENGTH?  >>2938
  28DB  CHECK OPERATION CODE
  28DC  ZERO BLOCK? >>2941
  28DF  NO, $12/13 = $18/19 --> INPUT BLOCK
  28E9  $1A/1B --> END OF INPUT BLOCK
  28F6  COPY BLOCK ONLY? >>2965
  28F8  SAVE RELOCATION OPERATION CODE (2A8F)
  28FE  SAVE NUMBER OF RANGES TO CHECK (2A90)
  2902  ---
  2903  COPY START PAGES TO TABLE
  290E  ---
  290F  AND END PAGES
  291A  ---
  291B  AND FINALLY, RELOCATION FACTORS
  2923  BUMP TO NEXT TABLE ENTRY <296B>
  2926  RESTORE OPERATION CODE (2A8F)
  292B  RELOCATE INSTRUCTIONS? >>293B

292D *********** 2/3 - RELOCATE ADDRESSES ****************************

  292D  NO, RELOCATE ADDRESS <29CD>
  2930  COPY BLOCK <2976>
  2933  AND CONTINUE IF ALL WENT WELL >>28BC
  2936  NORMAL EXIT
  2937  RETURN
  2938  JUMP TO ERROR EXIT >>2A03
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2938
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

293B *********** 4 - RELOCATE INSTRUCTIONS ***************************

  293B  RELOCATE INSTRUCTIONS <29DF>
  293E  AND THEN COPY BLOCK >>2930

2941 *********** 0 - ZERO BLOCK ***************************************

  2941  BUMP TABLE POINTER TO NEXT ENTRY <296B>
  2946  GET NUMBER OF PAGES TO DO
  2948  NO FULL PAGES? >>2956
  294B  ZERO AN ENTIRE PAGE
  2950  BUMP PAGE POINTER
  2952  AND DECREMENT LENGTH
  2956  GET LENGTH OF PARTIAL LAST PAGE
  2958  NO PARTIAL PAGE? >>2962
  295B  ZERO PARTIAL PAGE TOO
  2962  DONE, GET NEXT TABLE ENTRY >>28BC

2965 *********** I - COPY BLOCK ***************************************

  2965  BUMP TABLE POINTER <296B>
  2968  AND GO COPY BLOCK >>2930

296B *********** ADVANCE TABLE POINTER ********************************

  296B  ADD FINAL ENTRY INDEX..
  296F  TO TABLE ENTRY ADDRESS
  2975  RETURN

2976 *********** COPY BLOCK ***************************************

  2976  ---
  297A  INPTR < OUTPTR? >>2987
  297C  NO, GREATER? >>29AA
  297E  MSB'S ARE EQUAL, CHECK LSB'S ALSO
  2986  EXIT IF EQUAL
  2987  INPTR < OUTPTR, COPY LAST PAGES FIRST
  298B  BUMP BOTH INPTR AND OUTPTR BY...
  298D  LENGTH-1 TO POINT AT LAST BYTE
  2995  START WITH SHORT LAST PAGE LENGTH
  2999  ---
  299A  COPY BYTES BACKWARDS THROUGH MEMORY
  29A1  DROP ADDRESSES AND LENGTH BY 256
  29A7  AND CONTINUE UNTIL FINISHED >>2999
  29A9  RETURN
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 29A9
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  29AA  INPTR > OUTPTR, COPY PAGES FORWARD
  29AC  HOW MANY FULL PAGES LEFT?
  29AE  NONE? >>29BF
  29BØ  COPY A FULL PAGE
  29B7  AND BUMP ADDRESSES
  29BB  DECREMENT LENGTH BY 256
  29BD  AND DO ALL PAGES >>29BØ
  29BF  GET LENGTH OF LAST PAGE
  29C1  EVEN PAGE BOUNDARY? >>29CC
  29C3  NO, COPY SHORT LAST PAGE
  29CC  RETURN

29CD *********** ADDR/PAGE RELOCATE ***********************************

  29CD  GET TABLE ENTRY TYPE (2A8F)
  29D1  GET PAGE TO RELOCATE
  29D3  RELOCATE A SINGLE ADDRESS <2AØB>
  29D6  BUMP BY 1 OR 2 BYTES (2A8F)
  29D9  ADVANCE POINTER <2A27>
  29DC  AND CONTINUE UNTIL COMPLETE >>29CD
  29DE  RETURN

29DF *********** INSTRUCTIONS RELOCATE ********************************

  29DF  ---
  29E1  GET 65Ø2 OPCODE
  29E3  COMPUTE INSTRUCTION LENGTH <2A3A>
  29E6  INVALID OPCODE? >>29F9
  29E8  3 BYTE INSTRUCTIONS?
  29EA  NO >>29F3
  29EC  YES, 3 BYTE ADDRESS TO CORRECT
  29EE  RELOCATE ADDRESS <2AØB>
  29F1  AND ADVANCE BY 3 BYTES
  29F3  NEXT INSTRUCTION <2A27>
  29F6  CONTINUE UNTIL FINISHED >>29DF
  29F8  RETURN

        ******** INVALID OPCODE *****************

  29F9  POP THE STACK
  29FB  RETURN WITH POINTER TO BAD INSTRUC.
  29FF  DIE HORRIBLY
  2AØ2  RETURN

2AØ3 *********** ERROR RETURN ***************************************
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2AØ3
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2AØ3  RETURN WITH POINTER
  2AØ7  EXIT WITH ERROR CODE
  2AØA  RETURN

2AØB *********** RELOCATE ABSOLUTE ADDRESS ****************************

  2AØB  GET PAGE NUMBER TO CHECK
  2AØD  GET NUMBER OF RANGES (LESS ONE) (2A9Ø)
  2A1Ø  IS IT PRIOR TO START OF THIS RANGE? (2A91)
  2A13  YES? >>2A1C
  2A15  NO, IS IS AFTER END OF RANGE? (2A99)
  2A18  NO? >>2A2Ø
  2A1C  ---
  2A1D  CHECK EACH RANGE >>2A1Ø
  2A1F  RETURN

  2A2Ø  ---
  2A21  ADD FUDGE FACTOR TO ADDRESS (2AA1)
  2A24  AND UPDATE IT
  2A26  RETURN

2A27 *********** BUMP POINTER TO NEXT ADDR ****************************

  2A27  ---
  2A28  ADD LENGTH TO POINTER
  2A2F  CHECK TO SEE IF WE ARE DONE
  2A35  ---
  2A39  RETURN

2A3A *********** COMPUTE INSTRUCTION LENGTH ***************************

  2A3A  A-REG CONTAINS OPCODE
  2A3B  ISOLATE LAST TWO BITS FOR LATER
  2A4Ø  USE LAST 6 BITS AS TABLE INDEX
  2A42  GET BYTE WITH 4 LENGTHS IN IT (2A4F)
  2A45  ---
  2A46  USING TOP TWO BITS AS INDEX... >>2A4C
  2A48  SHIFT DOWN THE PROPER LENGTH
  2A4C  AND ISOLATE IT IN A-REG
  2A4E  RETURN

2A4F *********** 65Ø2 OP LENGTH TABLE *********************************
          EACH BYTE CONTAINS FOUR 2 BIT LENGTHS

  2A4F  ---
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2A8B
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

2A8F ********** RELOCATION DATA ************************************

  2A8F  RELOCATION CODE (3,2,1)
  2A90  NUMBER OF RANGES
  2A91  START OF RANGE PAGES
  2A99  END OF RANGE PAGES +1
  2AA1  ADDITIVE FACTORS

2AA9 ********** 2AA9-2AFF NOT USED **********************************

  2AA9  NOT USED
  2AEC

2B00 ********** SET UP RAMDRIVE IN AUXMEM **************************
         (THIS ROUTINE PUTS THE RAMDRIVE DEVICE DRIVER
          IN MEMORY, PUTS THE ADDRESS OF THE DRIVER
          IN THE DEVICE DRIVER ADDRESS LIST, AND
          ADDS THE RAMDRIVE TO THE ONLINE DEVICE LIST.)

  2B00  ---
  2B02  RELOCATE RAMDRIVE CALLER NOW AT.. (2E00)
  2B05  TO HIGH RAM AT.. (FF00)
  2B0D  NOW PREPARE TO MOVE
  2B0F  RAMDRIVE DEVICE DRIVER
  2B11  INTO AUX RAM AT $200.
  2B14  $3C/$3D --> $2C00
  2B18  $3E/$3F --> $2DFF
  2B1D  $42/43 --> $200
  2B23  COPY MAIN MEM TO AUX MEM
  2B24  USE AUXMOVE TO COPY IT <C311>
  2B29  SLOT 3, DRIVE 2 DEVICE DRIVER.. (BF26)
  2B2C  IS AT $FF00
  2B31  BUMP DEVICE COUNT (BF31)
  2B37  ADD DEVICE TO ONLINE DEVICE LIST
  2B3C  RETURN

2B3D ********** 2B3D-2BFF NOT USED **********************************

  2B3D  ---
  2B7D

2C00 ******* RAMDRIVE (/RAM) DEVICE DRIVER ***************************
         (COPIED TO AND RUN AT $200 IN AUX RAM)
         (THIS IS THE MAIN PART OF THE DEVICE DRIVER.
          IT IS CALLED BY THE RAMDRIVE CALLER
          WHICH IS LOCATED AT $FF00 IN MAIN MEMORY.)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2C00
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2C00  SAVE THE 80STORE SETTING (C018)
  2C04  FORCE RAM READ/WRITE (C000)
  2C09  COPY INPUT PARAMETERS
  2C0B  TO AUX PAGE 3. (03BD)
  2C11  FIRST TIME IN OR FORMAT COMMAND? (03BC)
  2C14  NO, SKIP FORMAT LOGIC >>2C4F

        ******** FORMAT RAMDRIVE ****************

  2C16  YES, SAVE BLOCK WANTED
  2C18  PAGES $E AND $F ARE ACTUAL DIRECTORY
  2C1A  ZERO THE DIRECTORY BLOCK <0333>
  2C1F  COPY VOLUME NAME ($F3,"RAM")  (03D2)
  2C22  TO VOLUME DIRECTORY BLOCK (0E04)
  2C28  LAST BYTE IN VOLUME BITMAP
  2C2A  IS AN $FE (03D1)
  2C2D  $FF TO ACCUM.
  2C30  14 $FF'S TO BITMAP (03C2)
  2C36  SET FIRST BITMAP BYTE TO ZERO (03C2)
  2C39  COPY 8 BYTES
  2C3B  OF DIRECTORY DATA (03D6)
  2C3E  TO VOLUME DIRECTORY BLOCK (0E22)
  2C44  WAS THIS A FORMAT COMMAND? (03BC)
  2C47  YES, DONE. >>2CAA
  2C49  NO, SET FLAG & CONTINUE WITH READ/WRITE (03BC)
  2C4C  RESTORE BLOCK NUMBER (03C1)

        ******** READ/WRITE RAMDRIVE BLOCK ******

  2C4F  CONVERT BLOCK NUMBER TO PAGE NUMBER (03C1)
  2C55  THIS PAGE IN HIGH RAM?
  2C57  YES >>2C63
  2C59  NO, IS IT BLOCK 3? (VOLUME BIT MAP)
  2C5B  NO >>2C60
  2C5D  YES, DUMMY UP A PHONY BITMAP BLOCK >>038C
  2C60  ELSE, NORMAL READ/WRITE >>0342

        ******** READ/WRITE IN AUX HIGH RAM *****

  2C63  SAVE PAGE NUMBER
  2C64  FIND IT IN MEMORY <02E5>
  2C67  REMEMBER READ/WRITE STATUS
  2C68  WRITING? >>2CB8
  2C6A  GET SAVED PAGE NUMBER
  2C6B  DOES OPERATION INVOLVE BANK1?
  2C6D  NO, USE BANK2 >>2C73
  2C6F  YES, FORCE IT TO $DXXX
  2C71  AND USE BANK1 OF AUX HIGH RAM >>2C79
  2C73  USE BANK2 OF AUX HIGH RAM (C083)
  2C76  AND WRITE ENABLE IT (C083)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2C79
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2C79  SAVE PAGE NUMBER IN BLOCK (Ø3C1)
  2C7C  PRESERVE HIS BUFFER ADDR (Ø3CØ)
  2C8Ø  DURING THE FOLLOWING TRANSFER... (Ø3BF)
  2C83  SELECT AUX HIGH RAM (CØØ9)
  2C88  USE RAMDRIVE BUFFER AS AN "IN BETWEEN" (Ø3C0)
  2C8B  AREA WHEN TRANSFERING TO/FROM AUX HIGH RAM.
  2C8D  PRETEND THAT WAS CALLER'S BUFFER (Ø3BF)
  2C9Ø  AND SET UP POINTERS AGAIN <Ø2E5>
  2C94  COPY BLOCK TO OR FROM RAMDRIVE BUFFER
  2C9F  THEN BACK TO MAIN ZERO PAGE (CØØ8)
  2CA2  RESTORE CALLER'S BUFFER ADDRESS (Ø3BF)
  2CA9  READING OR WRITING?
  2CAA  IF WRITING, DONE >>2CB5
  2CAC  IF READING, WRITE ENABLE HIGH RAM (BANK1) (CØ8B)
  2CB2  AND COPY RAMDRIVE BUFFER TO HIS BUFFER <Ø2BE>
  2CB5  THEN EXIT >>Ø3DE
  2CB8  IF WRITING, COPY HIS BLOCK TO RAMDRIVE BUFFER <Ø2BE>
  2CBB  THEN COPY RAMDRIVE BUFFER TO AUX HIGH RAM >>Ø26A

2CBE *********** COPY BLOCK IN MAIN 48K ******************************

  2CBE  THIS ENTRY IS FOR THE RAMDRIVE BUFFER
  2CCØ  THIS ENTRY ASSUMES AUX MEM PAGE NUMBER IN ACCUM (Ø3C1)
  2CC3  THIS ENTRY ASSUMES PAGE NUMBER ALREADY SET <Ø2E5>
  2CC6  WRITING TO RAMDISK? >>2CDB
  2CC8  NO, WRITE TO MAIN 48K RAM (CØØ4)
  2CCC  COPY BLOCK AUX MEM --> MAIN MEM
  2CD7  WRITE TO AUX MEM AGAIN (CØØ5)
  2CDA  DONE (RETURN HERE AFTER FOLLOWING JUMP)
  2CDB  ---
  2CDD  GO BACK TO MAIN MEM PART OF DRIVER (Ø3ED)
  2CEØ  TO COPY MAIN MEM --> AUX MEM

2CE5 *********** SET BUFFER AND BLOCK ADDRESSES **********************

  2CE5  GET COMMAND (Ø3BD)
  2CE8  READ OR WRITE?
  2CE9  WRITE? >>2DØ8
  2CEB  NO, GET HIGH BYTE OF BUFFER TO BE READ (Ø3CØ)
  2CF2  AND LOW BYTE OF BUFF ADDRESS (Ø3BF)
  2CF5  $42/43 --> FIRST PAGE OF BUFFER
  2CF7  $4Ø/41 --> SECOND PAGE OF BUFFER
  2CF9  GET PAGE NUMBER (Ø3C1)
  2CFE  $3C/3D --> BLOCK IN RAMDRIVE
  2DØØ  $3E/3F --> SECOND PAGE OF SAME
  2DØ6  ALWAYS BRANCH AROUND WRITE CODE >>2D23
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2DØ6
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2DØ8  WRITE,  (Ø3CØ)
  2DØF  $3C/3D --> MAIN MEMORY ADDRESS OF BUFFER TO BE WRITTEN (Ø3BF)
  2D12  $3E/3F --> SECOND PAGE OF SAME
  2D19  $42/43 --> BLOCK IN RAMDRIVE
  2D1B  $4Ø/41 --> SECOND PAGE OF SAME
  2D23  SET SECOND PAGE ADDRESSES
  2D27  EXIT

2D28 *********** SEND HIM A DUMMY BLOCK OF ZEROES*********************

  2D28  ZERO RAMDRIVE BUFFER IN CASE READING <Ø331>
  2D2B  COPY BETWEEN RAMDRIVE BUFFER AND HIS BUFFER <Ø2C3>
  2D2E  AND EXIT >>Ø3DE

2D31 *********** ZERO BLOCK BUFFER ***********************************

  2D31  ZERO RAMDRIVE BUFFER
  2D33  ZERO BLOCK INDICATED BY ACCUM. (Ø3C1)
  2D36  SET UP BUFFER POINTERS <Ø2E5>
  2D3A  ZERO BOTH PAGES OF BLOCK
  2D41  AND EXIT

2D42 *********** READ/WRITE IN LOW 48K ******************************

  2D42  BLOCK 2 (VOLUME DIRECTORY)?
  2D44  NO >>2D4A
  2D46  YES, CONVERT IT BLOCK 7
  2D48  AND GO DO I/O NOW >>2D58
  2D4A  ELSE, LESS THAN BLOCK 8?
  2D4C  YES, RETURN WITH DUMMY ZERO BLOCK. >>2D28
  2D4E  START MSB AT ZERO
  2D5Ø  GET ORIGINAL BLOCK NUMBER
  2D52  BLOCK $5D THROUGH $5F?
  2D54  NO >>2D5B
  2D56  YES, ADJUST TO $D THROUGH $F
  2D58  AND USE $1AØØ THRU $1FFF IN RAMDRIVE. >>Ø385
  2D5B  ELSE, FOR BLOCKS $8 THRU $5C
  2D5C  SUBTRACT 8
  2D5E  AND DIVIDE BY 17 ($11)
  2D64  XREG IS QUOTIENT
  2D65  HAS TO BRANCH!! >>2D5E
  2D68  AND AREG IS REMAINDER
  2D69  REMAINDER OF 1?
  2D6B  NO >>2D73
  2D6D  YES, EVERY 17TH BLOCK GOES
  2D6E  IN $1ØØØ-$1BFF AREA
  2D6F  BY ADDING 8 TO QUOTIENT
  2D71  AND GO DO IT >>2D85
  2D73  BUMP QUOTIENT (START AT $2XXX)
  2D75  SHIFT IT TO TOP NIBBLE OF BYTE
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2D7D
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2D7D  GOT A REMAINDER? >>2D81
  2D7F  IF SO, DECREMENT IT (NOT USING 1)
  2D81  THEN ADD INTO TOP NIBBLE
  2D82  TO FORM $10 THRU $5F (03C1)
  2D85  BLOCK*2 FOR PAGE NUMBER
  2D86  COPY THE BLOCK <02C0>
  2D89  THEN EXIT >>03DE

2D8C ********** READ/WRITE BITMAP BLOCK ****************************

  2D8C  USE RAMDRIVE BUFFER (NO ACTUAL BITMAP BLOCK)
  2D91  SET UP BUFFER POINTERS <02E5>
  2D94  WRITING? >>2DA9
  2D96  NO, READING - ZERO THE RAMDRIVE BUFFER <0336>
  2D9B  COPY BITMAP IMAGE TO RAMDRIVE BUFFER (03C2)
  2DA3  COPY BLOCK BACK TO CALLER'S BUFFER <02C3>
  2DA6  THEN EXIT >>03DE

  2DA9  WRITING, COPY HIS BUFFER TO RAMDRIVE BUFFER <02C3>
  2DAC  SET UP BUFFER POINTERS <02E5>
  2DB1  COPY 16 BITMAP BYTES FROM RAMDRIVE BUFFER
  2DB3  INTO PAGE 3 BITMAP IMAGE (03C2)
  2DB9  THEN EXIT >>03DE

2DBC ********** RAM DRIVE DATA (AT $3BC) ***************************

  2DBC  FIRST TIME ENTRY FLAG
  2DBD  COMMAND FROM PARM LIST
  2DBE  UNIT NUMBER FROM PARM LIST
  2DBF  BUFFER ADDRESS FROM PARM LIST
  2DC1  BLOCK NUMBER FROM PARM LIST

  2DC2  BIT MAP IMAGE FOR RAM DRIVE

  2DD2  RAMDRIVE VOLUME NAME
  2DD3  'RAM'
  2DD6  ACCESS, ENTRY LENGTH
  2DD8  NUMBER OF ENTRIES
  2DD9  FILE COUNT
  2DDB  BIT MAP BLOCK POINTER
  2DDD  BLOCKS ON DISK

2DDE ********** EXIT TO MAIN MEMORY *********************************

  2DDE  WRITE ENABLE HIGH RAM (BANK1) (C08B)
  2DE5  RESTORE 80STORE STATUS >>2DEA
  2DE7  80STORE WAS ON (C001)
  2DEA  GO AROUND MEMORY USED BY XFER >>03EF
  2DED  LOW-ORDER BYTE AND
  2DEE  HIGH-ORDER BYTE USED BY XFER ROUTINE
  2DEF  RETURN TO $FF44 (NORMAL EXIT)
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 2DFB
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2DFB  USE ROM XFER ROUTINE TO DO IT >>C314
  2DFE  TWO BYTES NOT USED

2E00 ******* RAMDRIVE CALLER (RUNS AT $FF00) ************************
          (USED TO CALL MAIN PART OF RAMDRIVE DEVICE
           DRIVER WHICH IS AT $200 IN AUX MEMORY.
           ROUTINE AT $FF65 IS USED TO TRANSFER DATA
           FROM MAIN TO AUX MEM.)

  2E00  ---
  2E03  SAVE ZPAGE STUFF I WILL CLOBBER
  2E05  FROM $3C THRU $47 (FF84)
  2E0D  SAVE $3ED/E THAT XFER ROUTINE WILL CLOBBER (03ED)
  2E16  COMMAND = STATUS?
  2E18  IF SO, SIMPLE EXIT WILL DO >>2E44
  2E1A  ELSE, TOO BIG A COMMAND NUM?
  2E1C  IF SO, ERROR >>2E3B
  2E1E  ELSE, INVERT BITS OF CMD
  2E20  AND SAVE IT
  2E22  FORMAT? >>2E2C
  2E24  NO, CHECK BLOCK NUMBER
  2E28  MUST BE <128 FOR RAMDRIVE
  2E2C  GOING TO $200 IN AUX MEMORY
FF33
  2E38  USE XFER ROUTINE TO GET THERE >>C314

  2E3B  I/O ERROR RETURN CODE
  2E3D  EXIT >>2E41
  2E3F  WRITE PROTECTED RETURN CODE
  2E41  ---
  2E42  ERROR EXIT >>2E47
  2E44  NORMAL EXIT, RETURN CODE IS 0
  2E47  ---
  2E4B  RESTORE ZERO PAGE (FF84)
  2E53  AND $3ED/E (FF82)
  2E56  HARMLESS INSTRUCTION MAKES SURE $FF58 IS AN RTS (6060)
          NOTE: THERE ARE ONLY THREE SURE THINGS IN LIFE:
                DEATH, TAXES, AND AN RTS AT $FF58.
  2E64   AND EXIT TO CALLER WHEN THRU

2E65 ********** COPY MAIN TO AUX BLOCK *****************************
          (CALLED FROM AUX MEM HANDLER)

FF65
  2E65  WRITE IN AUX 48K (C005)
  2E6A  COPY BOTH PAGES OF BLOCK
  2E75  WRITE IN MAIN 48K AGAIN (C004)
  2E7A  GO TO $2DA IN AUX MEMORY TO RETURN (03ED)
  2E7F  RETURN TO AUX MEM HANDLER AGAIN >>FF33
```

```
ProDOS Relocator -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: 2E7F
--------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
--------------------------------------------------------------------


2E82 *********** DATA AREA ****************************************

FF82
  2E82  SAVE $3ED,$3EE
FF83

FF84
  2E84  ZERO PAGE SAVE AREA

2E90 *********** $2E90-$2EFF NOT USED *******************************
          (NOTE: THE AREA FROM $FF90-FF99 IS RESERVED
           FOR THE /RAM CALLER.  FROM $FF9B TO $FFFF
           IS RESERVED FOR THE IRQ HANDLER.)

  2E90  NOT USED

2F00 *********** START OF MLI LOAD IMAGE ****************************

2F00    MLI LOAD IMAGE AT $2F00
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 2000
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

2000    MODULE STARTING ADDRESS

          *********************************
          *                               *
          *  PRODOS RELOCATOR             *
          *       LOADED AS THE FIRST     *
          *       PORTION OF THE PRODOS   *
          *       IMAGE AT $2000.         *
          *                               *
          *  VERSION 1.3 -- 2 DEC 86      *
          *                               *
          *********************************

          THE 1.3 VERSION OF THE PRODOS RELOCATOR IS
          INSTRUCTION FOR INSTRUCTION THE SAME FROM
          $2000 TO $25F5 AND FROM $2B00 TO $2EFF.
          SOME ADDRESSES IN THESE AREAS CHANGE BECAUSE
          THEY ARE ADDRESSES WITHIN THE MODIFIED PORTION
          OF THE RELOCATOR OR THE MLI.

          ONLY THE MODIFIED PORTION OF THE RELOCATOR
          ($25B1 TO $2AFF) IS DOCUMENTED HERE FOR VERSION 1.3.
          REFER TO THE 1.2 VERSION IN OTHER PARTS OF
          THE RELOCATOR.

25B1    ---

25B1 *********** DISPLAY LOAD MESSAGE *********************************

  25B1  CLICK SPEAKER (C030)
  25B4  STORE IN MAIN MEMORY  (C00C)
  25B7  80 COL DISPLAY OFF (C000)
  25BA  SET NORMAL VIDEO <FE84>
  25BD  CALL MONITOR INITIALIZATION <FB2F>
  25C0  SET VIDEO PR#0 <FE93>
  25C3  SET KEYBD IN#0 <FE89>
  25C6  OUT OF DECIMAL MODE
  25C7  CLEAR SCREEN <FC58>
  25CC  PRINT "APPLE //" (2605)
  25D7  PRINT "PRODOS 8 " ETC. ON ROW 12 (260D)
  25E2  PRINT 12 BLANKS ON ROW 14 (262B)
  25ED  PRINT "COPYRIGHT" ETC. ON ROW 23 (2637)
  25F8  PRINT "ALL RIGHTS RESERVED" ON ROW 24 (265E)
  2601  CLICK SPEAKER AGAIN (C030)
  2604  DONE
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 2605
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

2605 *********** DATA AREA *****************************************

  2605  'APPLE II'
  260D  'PRODOS 8 V1.3         2-DEC-86'
  262B  '                      '
  2637  'COPYRIGHT APPLE COMPUTER, INC., 1983-86'
  265E  'ALL RIGHTS RESERVED.'

  2672  8 BYTES FOR SMARTPORT STATUS CALL
  267A  DRIVER ADDRESS
  267C  SPACES LEFT ON DEVICE LIST
  267D  SLOT 2 FLAG (0 = PRODOS STORAGE DEVICE IN SLOT 2)

267E *********** DETERMINE SLOT CONFIGURATION ***********************

  267E  ---
  2680  ZERO SOME THINGS
  2687  DEVCNT=$FF (NO DEVICES YET) (BF31)
  268A  ALL 14 DEVICES ARE UNASSIGNED
  268F  FIRST CHECK SLOT 2
  2693  IS A STORAGE DEVICE IN SLOT 2? <28D4>
  2696  IF NOT, SET A FLAG (267D)
  2699  NOW POINT TO SLOT 7
  269D  STORAGE DEVICE IN SLOT? <28D4>
  26A0  NO. >>26FE
  26A2  GET $CSFF BYTE
  26A4  LOOKS LIKE 16 SECTOR DISK II. >>26CB
  26A6  LOOK LIKE 13 SECTOR DISK II?
  26A8  YES, DON'T USE IT. >>26FE

          ***** NON-DISK II STORAGE DEVICE ********

  26AA  CsFF BYTE = LOW BYTE OF DEVICE ADDRESS (267A)
  26AD  CHECK BYTE AT OFFSET 7
  26AF  TO SEE IF IT'S A SMARTPORT
  26B1  NOT A SMARTPORT INTERFACE >>26B6
  26B3  GO DO SMARTPORT STUFF >>2863
  26B6  ---
  26B8  GET $CSFE (STATUS BYTE)
  26BA  CAN WE AT LEAST READ STATUS AND DATA?
  26BE  ANTICIPATE FAILURE
  26BF  CAN'T READ IT. NO SENSE USING IT. >>26FE
  26C1  PUT LEFT NIBBLE OF STATUS BYTE IN $12 <28C9>
  26C5  PUSH CLC, INDICATING ONE DRIVE
  26C6  CARRY SET IF 2 OR 4 DRIVES
  26C7  GET HIGH BYTE OF SLOT ROM
  26C9  ALWAYS BRANCH INTO DISK II PROCESSING >>26D8
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 26C9
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

        ***** LOOKS LIKE A DISK II **************

 26CB   $12 = Ø FOR DISK II
 26CE   PUSH SEC ON STACK (DISK II HAS 2 DRIVES)
 26CF   GET LOW BYTE OF DISK II DRIVER ($ØØ) (27F7)
 26D2   SAVE IT IN RELOC DATA AREA (267A)
 26D5   GET HIGH BYTE OF DISK II DRIVER ($DØ) (27F8)

        ***** COMMON PROCESSING ***************

 26D8   SAVE DEVICE ADDRESS HIGH BYTE (267B)
 26DB   ESTABLISH DEVICE DRIVER IN GLOBAL PAGE <2833>
 26DE   ONLY ONE DRIVE?
 26DF   YES, GO TO NEXT SLOT >>26FD
        IF TWO DRIVES WERE ASSIGNED, MOVE THEM TO
        THE BOTTOM OF THE LIST IN REVERSE ORDER
 26FD   ---
        CARRY IS NOW CLEAR IF A PRODOS STORAGE DEVICE
        WAS FOUND IN THIS SLOT.  OTHERWISE, CARRY IS SET.
 26FE   GO MARK SLTBYT TO SHOW ROMS IN SLOT <2787>
 27Ø1   MOVE DOWN ONE SLOT
 27Ø7   WE'VE DONE ALL SLOTS >>27ØC
 27Ø9   CHECK NEXT SLOT >>269D
 2712   STASHED ANY DEVICES AT BOTTOM OF LIST? (267C)
 2715   NO. >>2739
 2717   YES, MOVE THEM BACK
 271F   IN REVERSE ORDER.
 2734   DONE WHEN X=Y (267C)
 2739   ---
 273B   START AT BOTTOM OF SEARCH LIST (BF31)
 273E   GET A DEVICE FROM LIST (BF32)
 2741   PUT IT ON THE STACK
 2744   IS IT THE CURRENT SLOT? (BF3Ø)
 2748   NO, KEEP LOOKING >>274C
 274A   YES, TAKE IT OFF THE STACK
 274B   INDICATE CURRENT SLOT FOUND
 274C   ---
 274D   MORE TO CHECK >>273E
 274F   GET DEVICE COUNT (BF31)
 2753   CURRENT SLOT NOT FOUND!  >>2769
 2755   PUT CURRENT DRIVE AT (BF3Ø)
 2758   BOTTOM OF SEARCH LIST (BF32)
 275C   ONLY ONE DEVICE ON LIST >>277Ø
 275F   ONLY ONE DRIVE ON BOOT SLOT >>2769
 2761   CHANGE DRIVE NUMBER
 2763   STORE OTHER DRIVE NEXT TO LAST (BF32)
 2767   CURRENT SLOT ONLY SLOT ON LINE >>277Ø
 2769   GET OTHER DEVICES
 276A   MOVE THEM AHEAD OF CURRENT DRIVE (BF32)
 276E   STILL MORE TO DO >>2769
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 276E
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

 277Ø   DO CHECKSUM ON ROM <2809>
 2773   DOESN'T SAY "APPLE II"! >>2779
 2775   WE'RE HAPPY, STORE FINISHED MACHID (BF98)
 2778   AND LEAVE
 2779   UNKNOWN MACHINE, SO DIE HORRIBLY! >>2545

277C ******** PUT A DEVICE ON DEVICE LIST ***************************

 277C   COMBINE DSSS with IIII
 2781   BUMP DEVICE COUNT BY ONE
 2782   AND ADD DRIVE TO SYSTEM SEARCH LIST (BF32)
 2785   ROLL LEFT ANTICIPATING ROLL RIGHT
 2786   RETURN

2787 *********** IDENTIFY I/O CARD **********************************

 2787   WE ALREADY FOUND ROM IN THIS SLOT >>27E8
 278B   CHECK SIGNATURE ON CARD FOR THUNDERCLOCK
 279Ø   NOT IT >>27AC
 2796   THUNDERCLOCK, WHICH SLOT?
 2798   SAVE SLOT NUMBER (LESS 1)
 279A   IN CLOCK CODE RELOCATION TABLE (22D1)
 279F   ENABLE CLOCK/CALENDAR JUMP IN GLOBALS (BF06)
 27A4   NO MACHID! >>277Ø
 27A6   INDICATE THAT A CLOCK IS PRESENT
 27A8   AND UPDATE MACHID
 27AA   GO MARK ROM IN THIS SLOT >>27E8
        CHECK FOR PASCAL 1.1 PROTOCOL
 27AC   ---
 27BØ   $Cs05 = $38?
 27B2   DOESN'T GET TO FIRST BASE >>27D7
 27B8   $Cs07 = $18?
 27BA   NO. >>27D7
 27CØ   $Cs0B = $01?
 27C2   NO, BAD SIGNATURE >>27D7
 27C7   YES, GET LEFT NIBBLE
 27C9   8Ø COLUMN CARD?
 27CB   NO, UNKNOWN CARD >>27D7
 27CF   NO MACHID! >>277Ø
 27D1   MARK 8Ø COLUMN CARD PRESENT
 27D3   AND UPDATE MACHID
 27D5   GO MARK ROM IN THIS SLOT >>27E8

 27D7   UNKNOWN CARD, CHECK ROM TO
 27DB   SEE IF IT WILL HOLD A VALUE
 27E1   FOR SOME TIME.
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 27E6
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  27E8  WE FOUND ROM IN THIS SLOT
  27EA  CONVERT SLOT NUMBER
  27ED  TO A BIT POSITION (2801)
  27F0  AND OR INTO SLTBYT (BF99)
  27F6  RETURN TO CALLER

27F7 *********** DATA AREA *********************************************

  27F7  DISK II DEVICE DRIVER ENTRY POINT

  27F9  DEVICE SIGNATURE FOR:
  27FB  +0,+2,+4,+6 = THUNDERCLOCK
  27FD  +1,+3,+5,+7 = DISK
  27FF  (+7 NOT CHECKED)

  2801  BIT POSITION TABLE FOR SLOTS
  2804   (ALSO USED IN CHECKSUM CALCS)

2809 *********** COMPUTE AUTOSTART ROM CHECKSUM **********************

  2809  ---
  280A  GET ZERO IN INDEX REGISTER (2801)
  280D  POINT TO $FB09 ("APPLE II" IN ROM)
  280F  MAKE SURE UPPER CASE
  2814  UPDATE CHECKSUM (2801)
  2817  PUT HIGH BIT IN CARRY (2801)
  281B  DO 8 BYTES IN ALL (2804)
  2820  ACCUM = $08
  2824  ACCUM = $80
  2826  TURN ON HIGH BIT (2801)
  2829  ADD A FUDGE FACTOR
  282B  OH NO! A CLONE! >>2830
  282D  PASSED THE TEST...RETURN WITH MACHID
  282F  RETURN
  2830  ELSE, RETURN WITH ZERO MACHID
  2832  RETURN

2833 ***DEVICE DRIVER IN GLOBAL PAGE *********************************

  2833  SAVE CARRY (NUMBER OF DRIVES)
  2834  GET HIGH BYTE OF SLOT ADDRESS
  2836  MAKE IT SLOT NUMBER
  2838  TIMES 2
  2839  USE LATER IN Y-REG
  283A  NOW GET SLOT*16 IN ACCUM
  283C  NOW HAVE 0SSS0000 (DRIVE 1)
  283D  PUT DEVICE ID ON DEVICE LIST <277C>
  2840  GET BACK CARRY (NUMBER OF DRIVES)
  2841  ROLL CARRY INTO ACCUM
  2842  ONLY ONE DRIVE. >>2848
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 2844
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2844  TWO DRIVES. BUMP DEVICE COUNT
  2845  AND PUT SECOND DRIVE ON SEARCH LIST (BF32)
  2848  STORE FINAL DEVICE COUNT (BF31)
  284B  SHIFT DRIVE INDICATOR BACK TO CARRY
  284C  GET LOW BYTE OF DEVICE DRIVER ADDRESS (267A)
  284F  PUT IN GLOBAL PAGE FOR DRIVE 1 (BF10)
  2852  ONLY ONE DRIVE >>2857
  2854  PUT IN GLOBAL PAGE FOR DRIVE 2 (BF20)
  2857  GET HIGH BYTE OF DEVICE DRIVER ADDRESS (267B)
  285A  PUT IN GLOBAL PAGE FOR DRIVE 1 (BF11)
  285D  ONLY ONE DRIVE >>2862
  285F  PUT IN GLOBAL PAGE FOR DRIVE 2 (BF21)
  2862  RETURN

2863 ******** HANDLE SMART PORT ***************************************

  2863  PUT LEFT NIBBLE OF STATUS BYTE IN $12 <28C9>
  2866  GET HIGH BYTE OF SLOT ROM ADDRESS
  2868  STORE IT IN RELOC DATA AREA (267B)
  286B  GET PRODOS ENTRY, LOW BYTE (267A)
  286E  POKE INTO PRODOS CALL (2895)
  2872  ADD THREE TO GET SMARTPORT ENTRY
  2874  POKE INTO SMARTPORT CALL (2898)
  287A  POKE IN HIGH BYTE TO SMARTPORT CALL (2899)
  287D  AND TO PRODOS CALL (2896)
  2880  CONVERT HIGH BYTE TO UNIT NUMBER
  2884  STORE UNIT NUMBER
  2886  PRODOS STATUS CALL
  2888  STORE AS COMMAND CODE
  288C  ALSO ZERO BLOCK NUMBER
  2890  SET BUFFER ADDRESS SET TO $1000
  2892  JUST IN CASE IT'S NEEDED.
  2894  SELF-MODIFIED TO CALL PRODOS DEVICE DRIVER. <0000>
  2897  SELF-MODIFIED TO CALL THE SMARTPORT <0000>
  289A  WITH A STATUS COMMAND.
  289B  PARMLIST AT $28AB
  289D  GET NUMBER OF DEVICES ON LINE (2672)
  28A0  NONE ON LINE! >>28C6
  28A2  INDICATE IF DRIVE 2 EXISTS.
  28A4  PUT DRIVER ADDRESS IN GLOBAL PAGE <2833>
  28A9  IS THIS SLOT 5?
  28AB  NO. >>28C6
  28AD  SLOT 2 BEING USED BY A STORAGE DEVICE? (267D)
  28B0  YES, TWO DRIVES IS ALL YOU GET! >>28C6
  28B2  GET NUMBER OF DEVICES AGAIN (2672)
  28B5  MORE THAN TWO DRIVES?
  28B7  NO. >>28C6
  28B9  SET CARRY IF DRIVE 4 EXISTS.
  28BB  PUT THEM IN SLOT 2
  28BF  PUT DRIVER ADDRESS IN GLOBAL PAGE <2833>
  28C6  GO PROCESS NEXT SLOT >>26FD
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 28C6
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

28C9 ******** CONVERT STATUS FOR ID BYTE ****************************

  28C9  GET STATUS BYTE
  28CD  SHIFT LEFT NIBBLE TO RIGHT NIBBLE
  28D1  PUT IT IN $12
  28D3  RETURN

28D4 ******** CHECK FOR PRODOS STORAGE DEVICE ************************

  28D4  RESET I/O CARD ROMS (CFFF)
  28D9  CHECK 3 BYTES ON CONTROLLER ROM
  28DE  ANTICIPATE FAILURE
  28DF  NOT A PRODOS STORAGE DEVICE >>28E6
  28E5  SUCCESS--THIS IS A PRODOS STORAGE DEVICE.
  28E6  RETURN

28E7 ******** COMMAND LIST FOR SMARTPORT CALL ************************

  28E7  3 PARAMETERS
  28E8  OVERALL STATUS CALL
  28E9  PUT STATUS DATA AT $2653
  28EB  STATUS CODE IS $ØØ

28EC *********** RELOCATION ROUTINE *********************************
           (X/Y REGS CONTAIN TABLE ADDR)

  28EC  SAVE PASSED TABLE ADDRESS
  28FØ  ACCESS IIGS STATEREG BYTE TO (CØ68)
  28F3  TURN OFF SLOT ROM, ENSURE ROM BANK Ø
  28F8  ---
  28FA  GET OPERATION CODE
  28FC  VALID OPERATION? (4 OR LESS)
  28FE  NO, ERROR >>2972
  29Ø2  $14/15 --> OUTPUT BLOCK
  29ØC  $16/17 --> LENGTH
  2915  NEGATIVE LENGTH? >>2974
  2917  CHECK OPERATION CODE
  2918  ZERO BLOCK? >>297D
  291B  NO, $12/13 = $18/19 --> INPUT BLOCK
  2925  $1A/1B --> END OF INPUT BLOCK
  2932  COPY BLOCK ONLY? >>29A1
  2934  SAVE RELOCATION OPERATION CODE (2ACB)
  293A  SAVE NUMBER OF RANGES TO CHECK (2ACC)
  293E  ---
  293F  COPY START PAGES TO TABLE
  294A  ---
  294B  AND END PAGES
  2956  ---
  2957  AND FINALLY, RELOCATION FACTORS
  295F  BUMP TO NEXT TABLE ENTRY <29A7>
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 2962
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2962  RESTORE OPERATION CODE (2ACB)
  2967  RELOCATE INSTRUCTIONS? >>2977

2969 *********** 2/3 - RELOCATE ADDRESSES ***************************

  2969  NO, RELOCATE ADDRESS <2AØ9>
  296C  COPY BLOCK <29B2>
  296F  AND CONTINUE IF ALL WENT WELL >>28F8
  2972  NORMAL EXIT
  2973  RETURN
  2974  JUMP TO ERROR EXIT >>2A3F

2977 *********** 4 - RELOCATE INSTRUCTIONS ***************************

  2977  RELOCATE INSTRUCTIONS <2A1B>
  297A  AND THEN COPY BLOCK >>296C

297D *********** Ø - ZERO BLOCK ***************************************

  297D  BUMP TABLE POINTER TO NEXT ENTRY <29A7>
  2982  GET NUMBER OF PAGES TO DO
  2984  NO FULL PAGES? >>2992
  2987  ZERO AN ENTIRE PAGE
  298C  BUMP PAGE POINTER
  298E  AND DECREMENT LENGTH
  2992  GET LENGTH OF PARTIAL LAST PAGE
  2994  NO PARTIAL PAGE? >>299E
  2997  ZERO PARTIAL PAGE TOO
  299E  DONE, GET NEXT TABLE ENTRY >>28F8

29A1 *********** 1 - COPY BLOCK ****************************************

  29A1  BUMP TABLE POINTER <29A7>
  29A4  AND GO COPY BLOCK >>296C

29A7 *********** ADVANCE TABLE POINTER ********************************

  29A7  ADD FINAL ENTRY INDEX..
  29AB  TO TABLE ENTRY ADDRESS
  29B1  RETURN

29B2 *********** COPY BLOCK *******************************************

  29B2  ---
  29B6  INPTR < OUTPTR? >>29C3
  29B8  NO, GREATER? >>29E6
  29BA  MSB'S ARE EQUAL, CHECK LSB'S ALSO
  29C2  EXIT IF EQUAL
  29C3  INPTR < OUTPTR, COPY LAST PAGES FIRST
  29C7  BUMP BOTH INPTR AND OUTPTR BY...
  29C9  LENGTH-1 TO POINT AT LAST BYTE
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 29D1
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  29D1  START WITH SHORT LAST PAGE LENGTH
  29D5  ---
  29D6  COPY BYTES BACKWARDS THROUGH MEMORY
  29DD  DROP ADDRESSES AND LENGTH BY 256
  29E3  AND CONTINUE UNTIL FINISHED >>29D5
  29E5  RETURN

  29E6  INPTR > OUTPTR, COPY PAGES FORWARD
  29E8  HOW MANY FULL PAGES LEFT?
  29EA  NONE? >>29FB
  29EC  COPY A FULL PAGE
  29F3  AND BUMP ADDRESSES
  29F7  DECREMENT LENGTH BY 256
  29F9  AND DO ALL PAGES >>29EC
  29FB  GET LENGTH OF LAST PAGE
  29FD  EVEN PAGE BOUNDARY? >>2A08
  29FF  NO, COPY SHORT LAST PAGE
  2A0B  RETURN

2A09 *********** ADDR/PAGE RELOCATE **********************************

  2A09  GET TABLE ENTRY TYPE  (2ACB)
  2A0D  GET PAGE TO RELOCATE
  2A0F  RELOCATE A SINGLE ADDRESS <2A47>
  2A12  BUMP BY 1 OR 2 BYTES (2ACB)
  2A15  ADVANCE POINTER <2A63>
  2A18  AND CONTINUE UNTIL COMPLETE >>2A09
  2A1A  RETURN

2A1B *********** INSTRUCTIONS RELOCATE ******************************

  2A1B  ---
  2A1D  GET 6502 OPCODE
  2A1F  COMPUTE INSTRUCTION LENGTH <2A76>
  2A22  INVALID OPCODE? >>2A35
  2A24  3 BYTE INSTRUCTIONS?
  2A26  NO >>2A2F
  2A28  YES, 3 BYTE ADDRESS TO CORRECT
  2A2A  RELOCATE ADDRESS <2A47>
  2A2D  AND ADVANCE BY 3 BYTES
  2A2F  NEXT INSTRUCTION <2A63>
  2A32  CONTINUE UNTIL FINISHED >>2A1B
  2A34  RETURN

        ******** INVALID OPCODE *****************

  2A35  POP THE STACK
  2A37  RETURN WITH POINTER TO BAD INSTRUC.
  2A3B  DIE HORRIBLY
  2A3E  RETURN
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86          NEXT OBJECT ADDR: 2A3E
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

2A3F *********** ERROR RETURN ***************************************

  2A3F  RETURN WITH POINTER
  2A43  EXIT WITH ERROR CODE
  2A46  RETURN

2A47 *********** RELOCATE ABSOLUTE ADDRESS ***************************

  2A47  GET PAGE NUMBER TO CHECK
  2A49  GET NUMBER OF RANGES (LESS ONE) (2ACC)
  2A4C  IS IT PRIOR TO START OF THIS RANGE? (2ACD)
  2A4F  YES? >>2A58
  2A51  NO, IS IS AFTER END OF RANGE? (2AD5)
  2A54  NO? >>2A5C
  2A58  ---
  2A59  CHECK EACH RANGE >>2A4C
  2A5B  RETURN

  2A5C  ---
  2A5D  ADD FUDGE FACTOR TO ADDRESS (2ADD)
  2A60  AND UPDATE IT
  2A62  RETURN

2A63 *********** BUMP POINTER TO NEXT ADDR ***************************

  2A63  ---
  2A64  ADD LENGTH TO POINTER
  2A6B  CHECK TO SEE IF WE ARE DONE
  2A71  ---
  2A75  RETURN

2A76 *********** COMPUTE INSTRUCTION LENGTH ***************************

  2A76  A-REG CONTAINS OPCODE
  2A77  ISOLATE LAST TWO BITS FOR LATER
  2A7C  USE LAST 6 BITS AS TABLE INDEX
  2A7E  GET BYTE WITH 4 LENGTHS IN IT (2A8B)
  2A81  ---
  2A82  USING TOP TWO BITS AS INDEX... >>2A88
  2A84  SHIFT DOWN THE PROPER LENGTH
  2A88  AND ISOLATE IT IN A-REG
  2A8A  RETURN

2A8B *********** 6502 OP LENGTH TABLE ********************************
          EACH BYTE CONTAINS FOUR 2 BIT LENGTHS
```

```
ProDOS Relocator -- V1.3 -- 2 DEC 86            NEXT OBJECT ADDR: 2A8B
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------


  2A8B  ---

2ACB ********** RELOCATION DATA ************************************

  2ACB  RELOCATION CODE (3,2,1)
  2ACC  NUMBER OF RANGES
  2ACD  START OF RANGE PAGES
  2AD0
  2AD5  END OF RANGE PAGES +1
  2ADD  ADDITIVE FACTORS

2AE5 ********** 2AE5-2AFF NOT USED **********************************

  2AE5  NOT USED

          THE REST OF THE RELOCATOR IS IDENTICAL
          TO VERSION 1.2
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: D700
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

D700    MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  PRODOS MACHINE LANGUAGE INTERFACE   *
          *       THIS CODE IS MOVED INTO HIGH   *
          *       RAM ($DE00-$FEFF) BY THE       *
          *       PRODOS RELOCATOR.              *
          *       IT PERFORMS ALL FILE MANAGEMENT *
          *       AND OTHER SYSTEM FUNCTIONS AND *
          *       SUPPORTS THE HARDWARE IN A     *
          *       DEVICE INDEPENDENT WAY.        *
          *                                      *
          *  VERSION 1.2 -- 6 SEP 86             *
          *                                      *
          ****************************************

D700 ********** ZERO PAGE USAGE ***************************************

0040    Pointer to caller's parmlist
0041
          -- device driver parmlist --
0042    Command
0043    Unit Number
0044    Buffer Pointer
0045
0046    Block Number
0047
          ----------------------------
0048    I/O Pointer - Index Block or..
0048    pointer into $F600 work buffer or..
0048    caller's pathname buffer pointer
0049
004A    I/O Pointer - Data Block
004B
004C    I/O Pointer - Data Block
004D
004E    I/O Pointer - Caller's Data or..
004E    buffer pointer passed in parmlist or..
004E    old I/O buffer
004F

D700 ********** MLI ERROR CODES ****************************************

0000    No Error
0001    Bad call type
0004    Bad parameter count
0025    Interrupt Table full
0027    I/O Error
0028    No device connected
002B    Write protected
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: D700
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

002E    Volume switched
0040    Invalid pathname syntax
0042    Too many files open
0043    Invalid REF NUM
0044    Nonexistent path
0045    Volume not mounted
0046    File not found
0047    Duplicate file name
0048    Disk full
0049    Volume Directory full
004A    Incompatible ProDOS version
004B    Unsupported storage type
004C    End of file
004D    Position past EOF
004E    Access error
0050    File already open
0051    File count bad
0052    Not a ProDOS disk
0053    Bad parameter
0055    VCB overflow
0056    Bad buffer address
0057    Duplicate volume mounted
005A    Bad volume bit map

D700 ********** SCREEN LOCATIONS ***************************************

0750    For direct movement of text to screen
07D0
07F1
07F2
07F3
07F4
07F5
07F6
07F7
07F8    Slot in use

D700 ********** RELOCATOR VARIABLE *************************************

2278    Flag=1 when running on a IIGS

D700 ********** SYSTEM GLOBAL PAGE EQUATES *****************************

BF00    Jump to MLI entry point
BF03    JSPARE (Jump to $EECF, QUIT code)
BF06    DATETIME vector
BF09    Jump to System Error
BF0C    Jump to System Death Handler
BF0F    System Error number
BF10    Device Driver address table
BF30    Slot/Drive last device
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: D700
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

BF31    Count (-1) active devices
BF32    List of active devices by DEVID
BF58    Memory BITMAP for low 48K
BF70    Open file 1 buffer address
BF7E    Open file 8 buffer address
BF80    Interrupt handler 1
BF82    Interrupt handler 2
BF84    Interrupt handler 3
BF86    Interrupt handler 4
BF88    A reg save during interrupt
BF89    X reg save during interrupt
BF8A    Y reg save during interrupt
BF8B    S reg save during interrupt
BF8C    P reg save during interrupt
BF8E    Interrupt return address
BF90    Date/Time
BF94    File open LEVEL
BF95    Backup bit
BF96    Temporary storage
BF9A    Prefix flag (0 = no prefix)
BF9B    MLI active flag
BF9C    Last MLI call return address
BF9E    MLI X reg savearea
BF9F    MLI Y reg savearea
BFA0    HIGH RAM entry/exit routines
BFD0    Interrupt entry/exit routines
BFF4    Bank switch saved state ($E000 byte)

D700 ********** SOFT SWITCHES ****************************************

C00C    Reset 80 column mode
C029    IIGS NEWVIDEO register
C051    Set TEXT mode
C053    Set Mixed text/graphics
C054    Display Primary page
C056    Set LORES graphics mode
C083    Read/Write RAM 2nd 4K Bank
C08B    Read/Write RAM 1st 4K Bank
CFFF    Reset alternate I/O ROMs

D700 ********** PATHNAME - DATA AREA *********************************
          ------------------------------------
          | L1 | NAME1 | L2 | NAME2 | .. | 00
          ------------------------------------
        Prefix is at top of buffer such that a
        negative index may be used to use it,
        wrapping around to the pathname again.
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: D700
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D700  pathname buffer

D800 ********* FILE CONTROL BLOCKS ***********************************

        File Control Block (FCB0) starts here..
  D800  Reference Number

          THE FOLLOWING 6 BYTES ARE THE FILE ID
  D801  Device Number
  D802  Dir Block HDR for Dir describing this File
  D804  Dir Block containing entry itself
  D806  File entry # in this Directory

  D807  Storage Type
          Flags
          1XXX XXXX   Index Block Buffer Changed
          X1XX XXXX   Data Block Buffer Changed
          XX1X XXXX   Unused
          XXX1 XXXX   Directory entry needs update
          XXXX 1XXX   Storage Type Changed
          XXXX X1XX   Allocate new Master Index Block
          XXXX XX1X   Allocate new Sub Index Block
  D808    XXXX XXX1   Allocate new Data Block
  D809  Access Byte
  D80A  Newline Character
  D80B  Buffer Number  (REF_NUM * 2)
  D80C  Master Index/Key Block Number
  D80E  Current Index Block
  D810  Current Data Block
  D812  Mark
  D815  End of File
  D818  Blocks Used
  D81A  not used
  D81B  Level
  D81C  Flag - Write occurred if MSB on
  D81D  not used
  D81F  Newline Enable Mask

  D820  FCB1 through FCB7

D900 ********** VOLUME CONTROL BLOCKS ********************************

        Volume Control Block (VCB0) starts here..
  D900  Length  (0000LLLL)
  D901  File Name (Max 15)
  D910  Unit Number
  D911  Files Open Flag (if $FF)
  D912  Total Blocks
  D914  Blocks Free
  D916  Block Number of Vol Dir Key Block
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: D918
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D918  not used
  D919  not used
  D91A  Bit Map Pointer
          Block offset into multi-block bitmap of
  D91C  next free bit.
  D91E  Count of open files

  D920  VCB1 through VCB7

DA00 ********** BITMAP BUFFER ***************************************

  DA00  Buffer 1st half

  DB00  Buffer 2nd half

DC00 ********** PRIMARY BUFFER ***************************************
         (Used for several things. DIRECTORY block offsets are
         mapped into it below)

  DC00  Pointer Fields
          *** DIRECTORY HEADER ***
  DC04  Type/Length  (TTTTLLLL)
  DC05  Volume Name  (Max 15)
  DC14  Reserved
  DC1C  Creation Datetime
  DC20  Version
  DC21  Min Version
  DC22  Access Byte
  DC23  Entry Length
  DC24  Entries per Block
  DC25  File Count
  DC27  Bitmap Pointer
DC29    Entry number within parent's block
  DC29  Total Blocks
  DC2A  Length of entries in parent
  DC2B  (remainder of first page of block)
  DD00  (second page of block)

DE00 ********** MLI MAIN ENTRY POINT *********************************

  DE00  Clear decimal mode
  DE01  Retrieve status byte from stack
  DE02  and store it in global page. (BF96)
  DE05  Save Registers (BF9F)
  DE0B  Set ($40) -> Address of function code -1
  DE0F  Set CMDADR -> True return address
  DE1C  Retrieve status byte, (BF96)
  DE1F  push it onto the stack,
  DE20  and pull it into status register.
  DE24  Init Global Page System error to 0 (BF0F)
  DE28  Get Function Code
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: DE2B
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  DE2B  Build hash index into Command Table (X reg)
  DE34  Is this function code valid?
  DE39  No >>DEB1
  DE3C  Set ($40) -> Parameter list
  DE49  Get parameter count required (FD4D)
  DE4C  None? >>DE6A
  DE4E  Is parameter count correct?
  DE50  No >>DEB5
  DE52  Check class of function (FD2D)
  DE55  Quit?
  DE57  yes >>DE67
  DE59  no,
  DE5A  $8X - Calls to I/O Drivers >>DE70
  DE5C  $CX/DX - Non System calls >>DE7B
  DE5E  Else, $4X - Interrupt support
  DE5F  Isolate type (0=ALLOC, 1=DEALLOC, 2=SPECIAL)
  DE61  Call Interrupt Support <DEFD>
  DE64  Then Exit to Caller >>DE82
  DE67  Go to quit code via global page >>BF03

DE6A ************************************************************
         ****** MLI GET_TIME CALL ******
         ******************************

  DE6A  Call Date/Time driver <BF06>
  DE6D  and exit to caller >>DE82

DE70 ************************************************************
         ****** MLI READ_BLOCK CALL *******
         ****** MLI WRITE_BLOCK CALL ******
         ******************************
         $80 - Read Block
         $81 - Write Block

  DE70  ---
  DE71  Set $42 -> 1 for READ, 2 for WRITE
  DE75  Do Block I/O <DEBC>
  DE78  Then Exit to Caller >>DE82

DE7B ********** $CX and $DX CALLS ***********************************

  DE7B  ---
  DE7C  Isolate function Index
  DE7F  Perform function and exit to caller <E03E>

DE82 ********** EXIT TO CALLER ***************************************
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: DE82
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  DE82  Clear Backup
  DE8A  Error occurred?
  DE8D  Save test results
  DE8E  Disable interrupts
  DEBF  Roll out most recent "active" bit (BF9B)
  DE92  Get test results back
  DE93  Store in X reg
  DE94  Set up Return Address on stack (BF9D)
  DE9C  Put test results on stack
  DE9E  Put error code in A reg
  DE9F  Restore X reg (BF9E)
  DEA2  Restore Y reg (BF9F)
  DEA5  Put error code on stack
  DEA6  Get RAM/ROM orientation (BFF4)
  DEA9  Exit via RAM Global Page >>BFA0

DEAC ********** NO DEVICE CONNECTED **********************************

  DEAC  ---
  DEAE  Call System Error Handler (Global Page) <BF09>

DEB1 ********** BAD SYSTEM CALL NUMBER ******************************

  DEB1  ---
  DEB3  Branch always taken >>DEB7

DEB5 ********** BAD PARAMETER COUNT **********************************

  DEB5  ---
  DEB7  Call System Error Handler <DEE1>
  DEBA  Exit to Caller >>DE82

DEBC ********** BLOCK I/O SETUP **************************************

  DEBC  ---
  DEBE  Save Old Processor Flags
  DEBF  Disable Interrupts
  DEC0  Copy Parameters to $43-$47
  DEC8  Save Starting Buffer Page in $4F
  DECD  Find last page + 1
  DED0  Round up if Buffer not page aligned >>DED3
  DED3  Is this Memory already in use? <FC63>
  DED6  Yes, then exit with error >>DEE0
  DED8  No, do Block I/O <DEE4>
  DEDB  Error? >>DEE0
  DEDD  No, then exit normally
  DEDF  RETURN
  DEE0  Error Exit
  DEE1  Call System Error Handler <BF09>
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: DEE1
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

DEE4 ********** Block I/O ***************************************************

  DEE4  ---
  DEE6  Force off unused UNIT bits
  DEED  Put Drive number in X reg
  DEF1  Put Device Handler Address in Jump Vector (FEBD)
  DEFA  Exit through Device Handler >>FEBD

DEFD ********** Interrupt Handler ***********************************
          ALLOC/DEALLOC

  DEFD  Save Call Type
  DEFF  Install unclaimed interrupt handler?
  DF01  No, normal ALLOC/DEALLOC >>DF09
  DF03  Yes, install a handler for unclaimed interrupts. <FD23>
  DF06  Error? >>DF35
  DF08   No, done.
  DF09  Test bit 0
  DF0A  1=DEALLOC >>DF38

          ALLOC

  DF0C  ---
  DF0E  Look for empty slot (BF7E)
  DF15  His Address better be non-zero
  DF19  Store Address of His routine in Global Page (BF7E)
  DF22  And return the position number we used
  DF28  Exit
  DF29  Skip this Vector
  DF2B  Last one?
  DF2D  No, check another >>DF0E
  DF2F  Yes, Table Full Error
  DF31  Always taken >>DF35
  DF33  Bad Parameter Error
  DF35  Call System Error Handler <BF09>

          DEALLOC

  DF38  ---
  DF3A  Get Position Number
  DF3C  Can't be zero >>DF33
  DF40  Or greater than 4 >>DF33
  DF43  Make Index into Table from it
  DF46  And zero His Vector (BF7E)
  DF4D  Then Exit
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: DF4D
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

DF4E ********** IRQ Handler ***********************************************

  DF4E  ---
  DF50  Save A reg from Monitor (BF88)
  DF53  And X,Y,S and P (BF89)
  DF5D  Is this ROM enhanced? (DFF1)
  DF60  Yes, skip three pulls >>DF6E
  DF67  And RTI Address (BF8E)
  DF6E  Replace stack to original condition
  DF72  Save active slot index (DFE7)
  DF75  In bottom half of stack?
  DF78  Yes, pop off 16 bytes and save them
  DF7A  ---
  DF81  Save $FA - $FF (top of zero page)
  DF83  ---
  DF8B  Is there a User Vector #1 (BF81)
  DF8E  No >>DF95
  DF90  Yes, call it <DFF3>
  DF93  His interrupt? >>DFBD
  DF95  Is there a User Vector #2 (BF83)
  DF98  No >>DF9F
  DF9A  Yes, call it <DFF6>
  DF9D  His interrupt? >>DFBD
  DF9F  Is there a User Vector #3 (BF85)
  DFA2  No >>DFA9
  DFA4  Yes, call it <DFF9>
  DFA7  His interrupt? >>DFBD
  DFA9  Is there a User Vector #4 (BF87)
  DFAC  No, didn't find service routine. >>DFB3
  DFAE  Yes, call it <DFFC>
  DFB1  His interrupt? >>DFBD
  DFB3  Allow 256 tries, (DFF2)
  DFB8  then indicate error type 1 and
  DFBA  call System Death Handler. <BF0C>
  DFBD  Interrupt Serviced
  DFBF  Restore zero page (FDBD)
  DFC7  And stack (BF8B)
  DFD7  Is this enhanced ROM? (DFF1)
  DFDA  Yes, skip some stuff we used to have to do >>DFEE
  DFDC  Reload X and Y (BF8A)
  DFE2  Disable I/O ROMS (CFFF)
  DFE5  Replace active slot number (C100)
  DFEE  Exit from Interrupt >>BFD0

  DFF1  ENHANCE FLAG. Set to 1 by RELOCATOR if new type ROM found.
        (That is, if ROM IRQ Vector jumps below $D000)
  DFF2  Unclaimed IRQ Count.  Incremented when an interrupt
        is unclaimed (256 tries are allowed).
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: DFF3
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  DFF3  User Interrupt Handler #1 >>BF80
  DFF6  User Interrupt Handler #2 >>BF82
  DFF9  User Interrupt Handler #3 >>BF84
  DFFC  User Interrupt Handler #4 >>BF86

DFFF ********** SYSTEM ERROR HANDLER ***********************************

  DFFF  Save Error Code (BF0F)
  E003  Pop out of subroutine
  E004  Exit to caller with Error Code (BF0F)
  E008  RETURN

E009 ********** SYSTEM DEATH HANDLER ***********************************

  E009  Save Error number in X-REG
  E00A  Turn off 80 column card (C00C)
  E00D  Select standard Text display (C051)
  E010  Are we running on a IIGS? (2278)
  E013  No. >>E01A
  E015  Yes, initialize IIGS video
  E017  by clearing NEWVIDEO. (C029)
  E01F  ---
  E021  Blank next to last row of screen and (0750)
  E024  print "INSERT SYSTEM DISK AND RESTART" (FDE6)
  E027  on bottom row of screen. (07D0)
  E02D  Get error number back
  E02E  Expect errors in range 00 to 0F
  E030  Make it ASCII
  E038  Put error number on screen (07F7)
  E03B  Infinite loop >>E03B

E03E ********** PERFORM FILING OR ***************************************
       ******* HOUSEKEEPING FUNCTIONS ******

  E03E  Save function index (FE7F)
  E041  Get INFO flags for this command (FD95)
  E044  Times 2
  E045  Store Command Number times 2 (FE7B)
  E04A  And use it to index into Address Table
  E04E  Set up Jump Vector with this function's (FEBD)
  E051  ..handler address (FD6E)
  E057  Signal Backup required after call
  E05C  PATHNAME not required? >>E063
  E05E  Required - parse and validity check <E081>
  E061  Bad Name? >>E07A
  E063  Reference Number in list? (FE7B)
  E066  No >>E06D
  E068  Yes - check it out <E1C7>
  E06B  Bad Number? >>E07A
  E06D  Date/Time in list? (FE7B)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E070
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E070  No >>E075
  E072  Yes - set System date just in case <BF06>
  E075  Call Function Handler <E07E>
  E078  If no errors then exit  >>E07D
  E07A  Else - call System error handler <BF09>
  E07D  Return to caller
  E07E  Indirect JUMP to Handler >>FEBD

E081 ********* CHECK CALLER'S PATHNAME  ******************************
       ****** COPY TO MY AREA          ******

  E081  Set ($48) -> Pathname
  E08C  ---
  E090  Assume partial Pathname (FE84)
  E093  No Pathname in my area yet (D700)
  E096  Check length of caller's Pathname
  E098  Zero is no good >>E0F2
  E09C  Nor is 65 or more >>E0F2
  E09E  Save length (FE66)
  E0A1  Length + 1 (FE66)
  E0A5  Get first character of his name
  E0A9  Is it "/"?
  E0AB  No >>E0B1
  E0AD  Yes - indicate fully qualified name (FE84)
  E0B0  Bump past "/"
  E0B1  ---
  E0B3  Length of Index level is -1 initially (D700)
  E0B6  First character of Index level (counter) (FE80)
  E0B9  Start of upcoming Index level in name (FE82)
  E0BC  At end of name yet? (FE66)
  E0BF  Yes >>E0F6
  E0C1  No - get next character in his name
  E0C7  Is it "/"?
  E0C9  Yes >>E10B
  E0CB  No - lower case?
  E0CD  No >>E0D1
  E0CF  Yes - force upper case
  E0D1  Copy to my Pathname buffer (D700)
  E0D4  Increment Index level counter (FE80)
  E0D7  Subsequent characters may be A-Z,0-9 or . >>E0DE
  E0D9  Increment Index level counter (FE80)
  E0DC  First character must be alphabetic >>E0EA
  E0DE  Is it "."?
  E0E0  Yes - get next character >>E0BC
  E0E2  No - is it special or control character
  E0E4  Yes - Bad Pathname then >>E0F2
  E0E6  Is it numeric?
  E0E8  Yes - get next character >>E0BC
  E0EA  Is it Alphabetic?
  E0F0  If so get next character >>E0BC
  E0F2  Else
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E0F3
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E0F3  Bad Pathname
  E0F5  RETURN
  E0F6  ---
  E0F8  Any characters in last Index level? (FE80)
  E0FB  Yes >>E101
  E0FD  No, zero characters in it (FE80)
  E100  And toss out last "/"
  E101  ---
  E102  Mark end of name with $00 (D700)
  E105  Name too long? >>E0F2
  E107  No - save final length (FE66)
  E10A  Set X -> 0
  E10E  Last Index more than 15 characters?
  E110  Yes - then no good >>E0F2
  E112  Save output Index (FE85)
  E115  Store length of previous Index level (FE82)
  E118  Just before it in buffer (D700)
  E11B  Restore output index (FE85)
  E11E  And continue >>E0B1
  E120  End of Name
  E121  Fully qualified name? (FE84)
  E124  Yes >>E12B
  E126  No - Got a Prefix (BF9A)
  E129  No - error >>E0F2
  E12B  Else, okay to exit

E12C ************************************************************************
       ****** MLI SET_PREFIX CALL ******
       ********************************

  E12C  Copy Pathname <E081>
  E12F  It's okay >>E13B
  E131  Check length of Volume name (D700)
  E136  If zero - no Prefix wanted (BF9A)
  E139  Exit with no error
  E13A  RETURN

  E13B  Get File entry for last index <E593>
  E13E  Okay? >>E144
  E140  Invalid Pathname?
  E142  No - Out now! >>E182
  E144  Sub Directory file? (FE27)
  E14B  No, error >>E180
  E14D  Fully qualified path? (FE84)
  E150  Yes >>E155
  E152  No - use old Prefix also (BF9A)
  E155  ---
  E157  Compute new Prefix Index (FE66)
  E15A  Does new Prefix exceed 64 characters?
  E15C  Yes - Bad Path error >>E0F2
  E15F  Store new Prefix pointer (BF9A)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E165
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E165  Set Device Number of Prefix Directory (FE67)
  E16B  Save Keyblock for Prefix Directory (FE68)
  E174  Copy Prefix to top of Path buffer (D700)
  E177  (preceded by old Prefix if one exists) (D700)
  E17F  Exit normally

  E180  Bad File Type Error
  E182  ---
  E183  RETURN

E184 ****************************************************************
       ****** MLI GET_PREFIX CALL ******
       ********************************

  E184  Set ($4E) -> Data Buffer
  E190  Set Length = 64 (max)
  E19A  Validity check buffer storage <FC46>
  E19D  Error? >>E182
  E1A1  Get Prefix index (BF9A)
  E1A5  No Prefix? - Length = 0 >>E1AB
  E1A7  Complement for length
  E1AB  Store in first byte of buffer
  E1AD  If null Prefix exit >>E1C5
  E1AF  ---
  E1B0  Copy Prefix to caller's buffer replacing (D700)
  E1B3  index level name length bytes with "/"
  E1BD  ---
  E1C1  End it with a "/"
  E1C5  ---
  E1C6  Exit normally

E1C7 ********** VALIDITY CHECK REFERENCE NUMBER **********************
                  (PASSED BY CALLER)

  E1C7  Get Reference Number
  E1CB  If zero then no good >>E228
  E1CF  If > 8 then no good >>E228
  E1D1  Save Reference Number
  E1D2  Multiply by 32
  E1D8  Result gives offset into FCB's (FE5A)
  E1DC  Get back Reference Number
  E1DD  File Control Block active this Reference? (D800)
  E1E0  No - Bad Reference Number >>E223
  E1E2  Get Buffer Number (D80B)
  E1E5  Find Buffer address in Global Page <FC00>
  E1EB  No Buffer? >>E214
  E1ED  Buffer okay, save Page Pointer in $48
  E1F1  Second block in $49
  E1F3  Set last Device used in Global Page (D801)
  E1F9  Finish setting up pointers (FEA5)
  E1FC  ($4A) -> 1st Block of Buffer (data)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E1FE
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E1FE  ($48) -> 2nd Block of Buffer (index)
  E200  ---
  E201  Search all Volume Control Blocks (D910)
  E204  for the one which goes with requested unit (D801)
  E209  ---
  E20F  Can't find matching Volume Control Block
  E211  So die with error type $0A <BF0C>
  E214  No Buffer in open File Control Block
  E216  So die with error type $0B <BF0C>
  E219  Is Volume mounted? (D900)
  E21C  No, keep looking >>E209
  E21E  Save Volume Control Block index (FE59)
  E222  Exit normally

  E223  ---
  E225  This looks wrong!!!! (FE5A)
  E228  Bad Reference Number error
  E22B  RETURN

E22C ****************************************************************
       ****** MLI ONLINE CALL ******
       ****************************

  E22C  Set ($4E) -> Data Buffer  <F1F5>
  E22F  Set Length = 0
  E239  Get Unit Number
  E23B  Do all Units? >>E244
  E23D  No, just one
  E23F  Set length = 16 (FEA2)
  E242  Always taken >>E249
  E244  If all Units
  E246  Set Length = 256 (maximum) (FEA3)
  E249  Is Buffer in main RAM? <FC46>
  E24C  No, then exit >>E281
  E24E  Yes, zero out Buffer
  E253  ---
  E258  Index into Data Buffer = $00 (FE82)
  E25D  Get Unit Number again
  E25F  Isolate valid bits
  E261  Specific Unit requested? >>E282
  E263  No, copy Device List from Global Page <E847>
  E266  Save Device Count (FE85)
  E269  Get last Device (FE92)
  E26C  Generate return data for it <E282>
  E26F  Bump data buffer index by 16 (FE82)
  E278  Get next Device (FE85)
  E27C  And go do it >>E266
  E27E  When done, exit
  E281  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E281
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E282  Save Device Number (BF30)
  E285  Scan for the Volume Control Block <E859>
  E288  Error? >>E2C5
  E28A  No
  E28E  Read block 2 (Volume Directory) <EBC9>
  E291  Get Volume Control Block offset (FE59)
  E294  Volume Directory read OK >>E2A5
  E296  Bad read, save error number
  E297  Any file open? (D911)
  E29A  Yes >>E2A2
  E29C  Zero out this VCB entry (D900)
  E2A2   Put error number in Accum
  E2A3  Always taken >>E2C5

  E2A5  Volume name exist? (D900)
  E2A8  No >>E2AF
  E2AA  Yes, Files open? (D911)
  E2AD  Yes >>E2BB
  E2AF  No, set up Volume Control Block for new VOL <E8B4>
  E2B2  Error?  >>E2C5
  E2B4  No
  E2B6  Was a duplicate Volume Control Block found? (FE7D)
  E2B9  Yes, then error >>E2C5
  E2BB  See if the same Volume is still there (FE59)
  E2C1  If not, Disk Switch Error
  E2C3  Else, all is well - continue >>E2E3

E2C5 ********** ERROR ***********************************************
          Store code in data buffer entry

  E2C5  ---
  E2C6  Store Device Number in entry <E2F8>
  E2CB  Store error code next
  E2CD  Duplicate Volume error?
  E2CF  No - done >>E2E1
  E2D2  Store Device Number for duplicate next (FE7E)
  E2DA  No Duplicate now
  E2E1  Exit with error
  E2E2  RETURN

E2E3 ********** MAKE ONLINE VOLUME ENTRY ****************************

  E2E3  Get name length for loop index (D900)
  E2EC  Copy name to Buffer entry (D900)
  E2F3  Done yet? (FE80)
  E2F6  No, do another >>E2EC
  E2F8  Yes, find current Buffer entry (FE82)
  E2FB  Store Device number (BF30)
  E303  Return to caller
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E303
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

E304 *************************************************************
          ****** MLI CREATE CALL ******
          ****************************

  E304  Follow Path to File <E5A6>
  E307  Error? - I'm expecting one >>E30D
  E309  If File was found - Duplicate error
  E30B  ---
  E30C  Return to caller

  E30D  File not found?
  E30F  No, then a real error occurred >>E30B
  E311  Yes, get requested storage type
  E315  Is it 00, $01, $02 or $03?
  E317  Yes, carry on >>E31D
  E319  Is it $0D?
  E31B  No, then exit with error >>E32D
  E31D  Get status of this device (BF30)
  E323  Exit on error >>E330
  E325  Is there a free Directory entry? (FE63)
  E328  No >>E331
  E32A  Yes - continue >>E3BF

  E32D  Indicate Bad Storage Type
  E330  Return to caller

  E331  Is this the Volume Directory? (FE0E)
  E337  No, we can extgnd it >>E33D
  E339  Yes, indicate Volume Directory Full error
  E33C  Return to caller

          * EXTEND DIRECTORY FILE *

  E33D  Save old current Block number
  E343  Allocate a Block on Disk <EA9C>
  E346  Save the number
  E347  Replace BLKNUM
  E34D  Was there a free Block?
  E34E  No, then exit >>E330
  E350  Yes, set up forward pointer in old one (DC02)
  E353  to point to it (DC03)
  E356  and Write old Directory Block <EBD5>
  E359  Error? Yes, then exit >>E330
  E35D  Set BLKNUM -> new Block number
  E362  Back point to old Directory Block (DC02)
  E368  Loop until done >>E35D
  E36C  Zero remainder of Block Buffer (DC02)
  E36F  (including forward pointer) (DD00)
  E373  Loop until done >>E36C
  E375  Write new Directory Block <EBD5>
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E378
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E378  Error? Yes, then exit >>E330
  E37A  Set BLKNUM -> Parent Directory block number (FE0E)
  E380  Read Block with my entry <EBC9>
  E383  Entry number within the Parent Dir. block (FE10)
  E386  None relocatable!!
  E388  Set ($48) -> Buffer
  E38A  Skip link pointers
  E38C  ---
  E38D  Count entries
  E390  Skip to next (FE11)
  E399  Save LSB
  E39D  Add 1 to Blocks used
  E39F  and $200 to EOF mark (FD96)
  E3A2  in entry
  E3A8  Loop until done >>E39D
  E3AA  Write back Block to Parent Directory <EBD5>
  E3AD  Error? then exit >>E3BE
  E3AF  Start all over now that there's room >>E304

E3B2 ********** ZERO $F600 ****************************************

  E3B2  Zero $F600 Block Buffer
  E3BE  Return to caller

E3BF ********** BUILD NEW FILE ************************************

  E3BF  Call Zero $F600 routine <E3B2>
  E3C2  Copy Datetime (Creation)
  E3C4  to my variables
  E3D0  Loop until done >>E3C4
  E3D2  Did he give Datetime (Creation)?
  E3D3  Yes, carry on >>E3E0
  E3D5  No, then use
  E3D7  System Datetime instead (BF90)
  E3E0  If Storage type is $00, $01, $02 or $03
  E3E2  force it to $10
  E3E8  else use a $D0
  E3EA  Find File name  (FE82)
  E3ED  OR Storage type to name length (D700)
  E3F0  Store Type/Length (FE27)
  E3F3  Isolate name length
  E3F7  Copy File name to File Entry Buffer (FE82)
  E405  Copy caller's Access Byte
          NOTE: This should be validity checked!!!
  E40D  and copy File type
  E412  ---
  E413  and AUX_TYPE
  E41C  Copy Version and Min_Version (0,0) (FDB8)
  E41F  constants to entry (FE43)
  E428  Indicate 1 Block used
  E42D  Copy Directory Header Block number (FE22)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E43C
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E43C  Is this a Seedling file?
  E43E  Yes >>E475
  E440  No, Directory file - Build Header in $F600
  E442  Copy completed Directory entry (FE27)
  E445  to $F600 buffer first (DC04)
  E449  Loop until done >>E442
  E44B  Make Storage type $E in Header itself
  E450  Put "HUSTON" (Author) in Reserved area
  E458  and Version, Min_Version, Access, (FDB8)
  E45B  Entry-length, File count and (DC20)
  E45E  Parent pointer from constants
  E45F  Loop until done >>E452
  E463  EOF = $200 (FE3D)
  E466  Copy Parent Block entry number (FE24)
  E46D  Loop until done >>E466
  E46F  Copy Parent entry Length (FE19)
  E475  Allocate a new disk block  <EA9C>
  E478  error? >>E4B1
  E47A  Store it in key pointer of entry (FE38)
  E480  and in BLKNUM for I/O
  E484  Write zeroed (or DIR HDR) key block <EBD5>
  E487  error? >>E4B1
  E489  Bump parent's file count (FE1B)
  E491  Go update directory <E4B2>
  E494  error? >>E4B1
  E496  Checkpoint Volume Bit Map and exit >>EB76

E499 ********** POINT $48/49 AT DIRECTORY ENTRY **********************

  E499  $48/$49 --> Entry
  E49D  Skip link pointers (+4)
  E49F  File entry number counter (FE26)
  E4A2  ---
  E4A3  Skip to proper entry
  E4A6  Add entry length (FE19)
  E4AB  (bump MSB)
  E4AF  (store LSB)
  E4B1  RETURN

E4B2 ********** UPDATE DIRECTORY(S) **********************************

  E4B2  System date available? (BF90)
  E4B5  no, forget it >>E4C2
  E4B9  yes, copy to last modified date field (BF90)
  E4C2  turn on BUBIT (backup) if appropriate (FE45)
  E4CB  set DEVNUM of parent (FE21)
  E4D1  and BLKNUM (FE24)
  E4D7  reread DIR block containing entry <EBC9>
  E4DA  error? >>E4B1
  E4DC  Point to proper entry in buffer <E499>
  E4E3  Copy constructed entry to buffer (FE27)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E4EE
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E4EE  Is this block the DIR HDR block?
  E4F9  no, write this modified directory block <EBD5>
  E4FC  error? >>E4B1
  E504  and then read DIR HDR block <EBC9>
  E507  error? >>E4B1
  E509  in any case..
  E50B  copy back update file count to HDR (FE1B)
  E514  and ACCESS byte (with Backup) (FE18)
  E51A  re-write the HDR block <EBD5>
  E51D  error? >>E573
  E51F  is this the VOL DIR? (DC04)
  E526  yes, all done -- exit >>E591
  E528  Is subdirectory, get PARENT_ENTRY, (DC29)
  E52B  store in variable area (FE26)
  E52E  Get PARENT_ENTRY_LENGTH, (DC2A)
  E531  store in variable area (FE19)
  E534  get parent block number (DC27)
  E53A  read Parent Directory block <EBC9>
  E53D  error? >>E573
  E53F  find entry for this subdirectory <E499>
  E542  system date available? (BF90)
  E545  no >>E554
  E547  yes,
  E54B  copy system date/time to... (BF90)
  E54E  modified date/time in entry
  E554  write it back <EBD5>
  E557  error? >>E573
  E55B  BLKNUM = HDR block number
  E564  same block we have now?
  E568  yes, go back and date stamp >>E51F
  E56A  no,
  E56E  read HDR block <EBD9>
  E571  and go back to date stamp parent DIR >>E51F
  E573  error? then exit

E574 ********** NOT ProDOS VOLUME ERROR ******************************

  E574  ---
  E577  RETURN

E578 ********** IS THIS ProDOS VOLUME? *******************************

  E578  Does previous block ptr = 0? (DC00)
  E586  no, not a ProDOS volume >>E574
  E588  else, (DC04)
  E58D  does VOL DIR's STORAGE TYPE = $E or $F?
  E58F  no, error >>E574
  E591  else, ok
  E592  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E592
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

E593 ********** GET FILE ENTRY ****************************************

  E593  follow path to it's end <E5A6>
  E596  error? >>E5A5
  E59B  copy file entry
  E5A3  and exit
  E5A5  RETURN

E5A6 ********** FOLLOW PATH TO A FILE *********************************

  E5A6  get base dir's data <E723>
  E5A9  error? >>E5FC
  E5AB  another subdirectory in the path? >>E5D4
  E5AD  no, at end of path
  E5AF  $48/$49 --> $F604 (HDR)
  E5B7  copy part of HDR to file entry
  E5C1  File type = $F (Directory) (FDB0)
  E5C4  BLOCK = 2 (FE27)
  E5C7  No. blocks used = 4
  E5C8  EOF = $800
  E5CC  TYPE = subdirectory ($D0)
  E5D1  return to caller
  E5D3  RETURN

          *** SCAN DIRECTORY FOR FILE ***

  E5D4  indicate no free entry found as yet
  E5D9  signal in HDR block
  E5DA  zero count of names examined
  E5DF  find name in block <E6CD>
  E5E2  got it! >>E644
  E5E4  not yet, how many entries expected? (FE60)
  E5E7  less entry number I just searched (FE5F)
  E5EC  more file entries left to search? >>E5FE
  E5FA  no, directory error
  E5FC  ---
  E5FD  RETURN

  E5FE  yes, update entries left counter (FE60)
  E603  back to first buffer page ($49)
  E605  check next block pointer (DC02)
  E60D  if zero, directory error >>E5FA
  E612  read next block of directory <EBC9>
  E615  no errors, loop back for more >>E5DA
  E617  exit if error
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E617
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

        *** NO MORE FILE ENTRIES ***

  E618  free entry found in directory? (FE63)
  E61B  yes >>E638
  E61D  no, check pointers (DC02)
  E620  is there another block after this one? >>E627
  E625  no... >>E638
  E627  yes, free entry will be.. (FE24)
  E630  first in that block
  E635  indicate free entry available (FE63)
  E638  find next index name <E764>
  E63B  exiting with error
  E63C  no more indicies in path, file not found >>E641
  E63E  else, path not found
  E640  RETURN

  E641  file not found error
  E643  RETURN

        *** FOUND FILE ENTRY ***

  E644  advance to next subdir in path <E75D>
  E647  end -- save entry no. and exit >>E6B5
  E64B  get type of entry
  E64F  subdir?
  E651  no, bad path then >>E63B
  E655  copy key block no...
  E657  to BLKNUM
  E65A  and to current DIR block no (FE22)
  E664  go read key block of subdirectory <EBD9>
  E667  error? >>E68D
  E66C  new file count (FE60)
  E675  check minimum version (DC21)
  E678  too new? >>E68B
  E680  count bits in reserved field of DIR hdr
  E681  --- >>E684
  E684  ---
  E687  there must be 5 bits on (normally $75)
  E689  (there are) >>E68F
  E68B  or else, incompatible file format
  E68D  ---
  E68E  RETURN

  E68F  copy DIR HDR <E695>
  E692  and go scan for next level >>E5D4
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E692
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

E695 ********* COPY DIRECTORY HDR ***********************************

  E695  Copy:
  E697  CREATION, VERSION, MIN_VERS, ACCESS, (DC1C)
  E69A  ENTRY_LEN, ENTRIES_PER_BLK, FILE_COUNT (FE12)
  E6A0  volume directory? (DC04)
  E6A7  if so, exit now >>E6B4
  E6AB  else, copy PARENT_POINTER, (DC27)
  E6AE  PARENT_ENTRY_NO., and PARENT_ENTRY_LEN (FE0E)
  E6B4  RETURN

E6B5 ********* SAVE DIR ENTRY NO. & BLOCK ****************************

  E6B5  compute entry number (FE1A)
  E6BE  save it  (FE26)
  E6C3  and the block it's in (FE24)
  E6CC  exit

E6CD ********* SEARCH ONE DIR BLOCK FOR FILE *************************

  E6CD  get entries in this block (FE1A)
  E6D3  $48/$49 --> first entry
  E6D9  ---
  E6DB  skip HDR? >>E710
  E6DD  no, non empty entry?
  E6E1  yes >>E6F0
  E6E3  no, do we need one? (FE63)
  E6E6  no >>E710
  E6E8  yes, remember it <E6B5>
  E6EB  don't need another one now (FE63)
  E6EE  skip to next entry >>E710
  E6F0  get length of name
  E6F2  count it (FE5F)
  E6F5  save it for loop (FE80)
  E6FB  same len as we are wanting? (D700)
  E6FE  no, skip it >>E710
  E700  ---
  E704  compare names (D700)
  E70E  we found it! exit
  E70F  RETURN

  E710  skip to next entry (FE62)
  E714  end of block? if so, exit >>E70F
  E71A  bump $48/$49 by entry len
  E721  and go check next >>E6D9
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E721
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

E723 ********* GET DIRECTORY DATA ***********************************

  E723  find base directory <E77C>
  E726  error? >>E77B
  E72C  zero out my variables (FE0E)
  E732  set up device number (BF30)
  E738  copy DIR HDR to my variables <E695>
  E741  copy TOTAL BLOCKS from VCB (D912)
  E747  copy BIT MAP Pointer from VCB (D91A)
  E74D  copy Block No. of this directory (0046)
  E753  make second copy of file count (FE1B)
  E75D  advance to next subdir in path <E764>
  E760  and update index (FE82)
  E763  RETURN

E764 ********* ADVANCE TO NEXT DIR NAME *****************************

  E764  get this DIR's index (FE82)
  E76B  add len of name to move index to next name (FE82)
  E76F  still in prefix portion? >>E777
  E771  no, now starting caller's path suffix (BF30)
  E774  save last DEVNUM accessed (FE67)
  E777  return with len of next dir in path (D700)
  E77B  RETURN

E77C ********* FIND BASE DIRECTORY ***********************************

  E77C  ---
  E77E  get old PFIXPTR (BF9A)
  E781  fully qualified pathname? (FE84)
  E784  no >>E787
  E786  yes, no old PFIXPTR anymore
  E787  save old prefix index (FE83)
  E78A  DEVNUM=0 (BF30)
  E78D  ---

          *** SCAN VCB'S FOR A MOUNTED VOLUME ***

  E78F  scan (D900)
  E792  got one >>E79F
  E799  else, bump to next VCB

          *** FIND LAST DIR IN PREFIX OR TOL DIR ***

  E79F  store name length (FE80)
  E7A2  same name as in pathname? (D700)
  E7A5  no -- skip it >>E794
  E7B3  save VCB index (FE59)
  E7B6  DEVNUM = VCB's unit no. (D910)
  E7BC  BLOCK = 2 (read VOLDIR if no old PFIX)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E7C4
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E7C4  get old prefix index (FE83)
  E7C7  ---
  E7C8  accumulate a new index (FE82)
  E7CB  no previous prefix? >>E7DD
  E7CE  find last name in prefix (D700)
  E7D3  read prefix directory instead of vol dir (FE68)
  E7DD  read block <EBD9>
  E7E0  error? >>E7E7
  E7E2  is this the right directory? <E881>
  E7E5  Yes--exit. >>E80B

          *** IF NOT THERE, REMOUNT ALL VOLS ***
          *** AND CHECK THEM                 ***

  E7E7  open files? (FE59)
  E7ED  yes, give up now >>E808
  E7EF  else, (FE83)
  E7F2  put back old prefix length (FE82)
  E7F5  copy DVCLST from global page <E847>
  E7FB  use last device accessed first >>E80C
  E7FD  if none, get last in my device table (BF31)
  E808  volume not found error
  E80B  RETURN

  E80C  ---
  E80F  search for device in device table (FE92)
  E817  device not found >>E808
  E819  when found, make it active device  (BF30)
  E81E  remove it from table (FE92)
  E821  find its VCB <E859>
  E824  not found? >>E846
  E826  volume mounted there? (FE59)
  E82C  no >>E833
  E82E  yes, open files here? (D911)
  E831  yes, skip it -- get next unit >>E7FD
  E833  else read block 2 (vol dir)
  E837  read volume directory <EBC9>
  E83A  error? >>E7FD
  E83C  mount volume on VCB <E8A7>
  E83F  error? >>E7FD
  E841  is this his chosen volume? <E881>
  E844  no, try again >>E7FD
  E846  yes, exit

E847 ********* COPY GLBL DEVLST TO MY TABLE **************************

  E847  start with last device (BF31)
  E84A  get a unit number (BF32)
  E84F  copy it to device table (FE92)
  E855  return count of devices (BF31)
  E858  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E858
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

E859 ********* SCAN VCB'S FOR DEVICE NO. ****************************

  E859  ---
  E85D  scan VCB's for a given device number
  E864  not it? >>E86B
  E866  is it, save VCB index (FE59)
  E869  and exit normally
  E86A  RETURN

  E86B  else, volume mounted here? (D900)
  E86E  yes >>E874
  E871  no, save VCB index to empty unit (FE59)
  E874  ---
  E876  bump to next VCB
  E878  and go look at it >>E85D
  E87A  not found...
  E87B  any free entries? if not, error >>E87E
  E87D  else, all is well -- return empty VCB
  E87E  VCB table full error
  E880  RETURN

E881 ********* COMPARE DIR NAME WITH PATH LVL ************************

  E881  ---
  E886  check DIR type (DC04)
  E889  VOL DIR or SUB DIR?
  E88B  neither >>E894
  E88D  yes..
  E88F  store len of its name (FE80)
  E892  and go on >>E899
  E894  error exit
  E895  RETURN

  E896  compare directory names (DC04)
  E89C  no match? >>E894
  E8A5  they match! exit
  E8A6  RETURN

E8A7 ********* MOUNT NEW VOLUME *************************************

  E8A7  volume mounted? (FE59)
  E8AD  no, continue >>E8B4
  E8AF  yes, same one as one wanted? <E90C>
  E8B2  if so exit, else fall thru >>E90B
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E8B4
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

E8B4 ********* SET UP VCB FROM VOLDIR ********************************

  E8B4  zero out VCB
  E8BF  is this a ProDOS volume? <E578>
  E8C2  no -- exit >>E90B
  E8C4  duplicate vol in VCB's? <E930>
  E8C7  yes -- exit with that one instead >>E90A
  E8C9  get new volume's name length (DC04)
  E8D0  add to VCB index (FE59)
  E8D4  and copy to VCB name field in empty VCB (DC04)
  E8DF  store in VCB name len field (D900)
  E8E2  copy DEVNUM to VCB unit field (BF30)
  E8E8  copy total blocks to VCB (DC29)
  E8F4  copy block no. of vol dir to VCB
  E8FE  copy bit map block no. to VCB (DC27)
  E90A  exit
  E90B  RETURN

E90C ********* COMPARE VOL NAMES TO MAKE *****************************
          ****** SURE THEY MATCH            ******

  E90C  Get length (DC04)
  E911  Same in VCB? (D900)
  E914  Save VCB offset (FE58)
  E917  Different from VCB >>E924
  E919  Store len to use as buffer index
  E91A  Add length to VCB offset to get (FE58)
  E91D  index into VCB (last char of name)
  E921  Compare names (D900)
  E924  SEC if no match
  E92B  CLC if match
  E92C  Restore VCB offset to X-REG (FE58)
  E92F  RETURN

E930 ********* LOOK FOR DUPLICATE VOL ********************************

  E930  start with first VCB
  E932  ---
  E933  this VCB has same name? <E90C>
  E936  no >>E947
  E938  yes, files open? (D911)
  E93B  yes >>E951
  E93F  no, mark VCB empty (NAME=0) (D900)
  E942  (UNIT=0) (D910)
  E945  and exit with no error >>E94F
  E947  else,
  E949  bump to next VCB
  E94D  and loop >>E932
  E94F  exit no errors
  E950  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E950
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E951  save flag (FE7D)
  E954  and VCB index of duplicate vol (FE7E)
  E957  exit with error
  E958  RETURN

E959 ********* SEE IF A QUANTITY OF FREE  ****************************
          ****** BLOCKS IS AVAILABLE ON VOL ******

  E959  any free blocks counted in VCB? (FE59)
  E962  yes >>E9B6

          *** COMPUTE VCB FREE BLOCK COUNT ***

  E964  no, how many bit map blocks are there? <EA08>
  E967  save it (less 1) (FE64)
  E96C  zero scratch (will count free blocks) (FE4E)
  E972  no block found yet
  E977  checkpoint bit map buffer <EB76>
  E97A  error? >>E9CA
  E97F  BLKNUM = bit map pointer (D91A)
  E989  read block to buffer <EBD9>
  E98C  error? >>E9CA
  E98E  count free blocks marked <E9CB>
  E991  drop no. remaining to do (FE64)
  E994  none left? >>E99F
  E996  some, BLKNUM = BLKNUM + 1
  E99C  go process that >>E989

  E99F  did we find a free bit? (FE59)
  E9A5  no -- volume full >>E9C7
  E9A7  save VCB bitmap block offset (D91C)
  E9AA  save free block count in VCB also (FE4F)
  E9B6  are there enough to satisfy request? (D914)
  E9C5  yes, exit
  E9C6  RETURN

  E9C7  volume full error
  E9CA  RETURN

E9CB ********* SCAN AND COUNT BITMAP BLOCKS ***************************

  E9CB  scan through both buffer pages
  E9D2  counting one bits  <E9F8>
  E9DD  ---
  E9E0  found free block already? (FE63)
  E9E3  if so -- done >>E9F7
  E9E5  any blocks found yet? (FE4E)
  E9EB  no >>E9F7
  E9ED  yes, compute total no. of bitmap blocks <EA08>
  E9F1  less number remaining (FE64)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: E9F4
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E9F4  gives bitmap block with first free bit (FE63)
  E9F7  exit

E9F8 ********* COUNT ONE BITS IN A BYTE ********************************

  E9F8  shift and...
  E9FB  count bits that are on (FE4E)
  EA03  exit when byte goes to zero
  EA07  RETURN

EA08 ********* COMPUTE NO. BITMAP BLKS -1 ******************************

  EA08  get blocks on vol count (-1) (FE59)
  EA14  ---
  EA15  isolate top nibble of block count
  EA16  for bit map block count
  EA19  RETURN

EA1A ********* FREE A BLOCK ON DISK ************************************

  EA1A  save MSB (FE64)
  EA1D  and LSB
  EA21  block number passed too big for (D913)
  EA24  volume size? (FE64)
  EA28  yes, error >>EA98
  EA2B  no, get bit position for block no.
  EA31  save it (FE63)
  EA35  divide block no. by 8 (FE64)
  EA38  giving byte offset as remainder
  EA41  save byte offset (FE6A)
  EA44  make quotient/2 into block index (FE64)
  EA47  remember which page in that block (FE6C)
  EA4A  read bit map block (after checkpoint) <EB43>
  EA4D  error? >>EA97
  EA4F  are we at proper block of bitmap yet? (FE71)
  EA55  yes! >>EA6D
  EA57  no -- checkpoint <EB76>
  EA5A  error? >>EA97
  EA5C  indicate block wanted in VCB (FE64)
  EA65  DEVNUM of bitmap (FE6E)
  EA68  read actual block directly <EB87>
  EA6B  error? >>EA97
  EA6D  get byte offset into page (FE6A)
  EA70  which page? (FE6C)
  EA73  get bit pattern to set (FE63)
  EA76  page 0? >>EA80
  EA78  no, turn bit on in page 1 (DB00)
  EA7E  and continue >>EA86
  EA80  turn bit on in page 0 (DA00)
  EA86  mark bitmap needs checkpoint
  EA8E  count block freed (FE8A)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EA96
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EA96  exit normally
  EA97  RETURN

  EA98  bad bitmap error
  EA9B  RETURN

EA9C ********* FIND A FREE DISK BLOCK AND ****************************
         ****** AND ALLOCATE IT             ******

  EA9C  go read bitmap <EB43>
  EA9F  error? >>EAC4
  EAA1  first page Ø
  EAA6  scan 1st page of bitmap for free block(s) (DAØØ)
  EAAE  bump tm page 1 of buffer (FE6C)
  EAB1  bump page offset (FE6B)
  EAB4  scan 2nd page too (DBØØ)
  EABC  bump page (FE6B)
  EABF  get next block <EB28>
  EAC2  continue  >>EAA1
  EAC4  error exit

  EAC5  save byte index (FE6A)
  EAC8  shift combination of page no. and (FE6B)
  EACB  byte offset left 3 bits to make (FE4F)
  EACE  room for bit position.
  EADD  depending on buffer page ... (FE6C)
  EAE2  reload bit pattern from page Ø... (DBØØ)
  EAE7  or page 1 (DAØØ)
  EAEA  shift bit pattern, bumping block no. LSB
  EAEB  until a one bit is found >>EAFØ
  EAFØ  then shift it back the way it was
  EAF1  (with that bit turned off) >>EAFØ
  EAF3  store LSB of block no. (FE4E)
  EAF6  store updated byte back in proper page (FE6C)
  EBØ3  indicate bitmap needs checkpoint
  EBØB  one less block available in VCB (FE59)
  EB2Ø  ---
  EB21  return with new block no. (FE4E)
  EB27  RETURN

EB28 ********* GET NEXT BITMAP BLOCK *********************************

  EB28  use blocks of vol to compute (FE59)
  EB2B  number of blocks in bitmap (D913)
  EB32  just scanned last block? (D91C)
  EB35  yes, no space >>EB72
  EB37  no, get next block (D91C)
  EB4Ø  checkpoint old one <EB76>
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EB4Ø
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

EB43 ********* READ BITMAP BLOCK ***************************************

  EB43  have we read bitmap for this unit yet? (FE59)
  EB4C  yes >>EB5C
  EB4E  no, checkpoint bitmap of some other unit <EB76>
  EB51  error? >>EB71
  EB56  get new bitmap unit no. (D91Ø)
  EB5C  was bitmap modified? (FE6D)
  EB5F  yes >>EB66
  EB61  no, read it <EB87>
  EB64  error? >>EB71
  EB66  save bitmap block offset times 2 (FE59)
  EB69  (page number) (D91C)
  EB7Ø  exit
  EB71  RETURN

  EB72  disk full error
  EB75  RETURN

EB76 ********* CHECKPOINT VOLUME BITMAP ********************************

  EB76  ---
  EB77  needs checkpoint? (FE6D)
  EB7A  no >>EB71
  EB7C  yes, write it <EBD1>
  EB7F  error? >>EB71
  EB81  doesn't need checkpoint now
  EB86  exit

EB87 ********* READ BITMAP ****************************************

  EB87  save DEVNUM (FE6E)
  EB8A  copy block offset wanted (FE59)
  EB94  BITMAP BLOCK = BITMAP PTR + BLOCK OFFSET (D91A)
  EBA2  set up read command

          *** READ OR WRITE BITMAP ***

  EBA4  save I/O command
  EBAA  device = bitmap device  (FE6E)
  EBBØ  block = bitmap block (FE6F)
  EBBA  point to bitmap buffer (EA82)
  EBBD  do the I/O <EBDF>
  EBC2  restore old DEVNUM (BF3Ø)
  EBC5  ok? >>EBC8
  EBC7  no, error exit
  EBC8  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EBC8
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

EBC9 ********* READ BLOCK DESIGNATED BY A,X **************************

  EBC9  Put low byte of block number in BLKNUM
  EBCB  and high byte in BLKNUM+1
  EBCD  Read a block <EBD9>
  EBD0  RETURN

EBD1 ********* WRITE BITMAP ***************************************

  EBD1  set up write command
  EBD3  and go do it  >>EBA4

EBD5 ********* WRITE BLOCK ***************************************

  EBD5  set up write command
  EBD7  and go do it >>EBDB

EBD9 ********* READ BLOCK ****************************************

  EBD9  set up read command

EBDB ********* READ OR WRITE BLOCK *******************************

  EBDB  save I/O command
  EBDD  where is my buffer?
  EBDF  save flags
  EBE0  and disable
  EBE3  Set low byte of Buffer pointer
  EBE5  to zero
  EBE7  Initialize Global Page System error to 0 (BF0F)
  EBEA  set I/O transfer occured flag
  EBEF  set unit to do I/O on (BF30)
  EBF4  do block I/O <DEE4>
  EBF7  error? >>EBFC
  EBF9  no errors, restore things and exit
  EBFB  RETURN

  EBFC  error exit
  EBFE  RETURN

EBFF ************************************************************
         ****** MLI GET_MARK CALL ******
         ******************************

  EBFF  copy mark to caller's list from FCB (FE5A)
  EC0F  exit with no errors
  EC10  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EC10
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EC11  bad position error
  EC14  RETURN

EC15 ************************************************************
         ****** MLI SET_MARK CALL ******
         ******************************

  EC15  set up to...
  EC1D  copy user's mark to temporary
  EC1F  new mark variable (FE70)
  EC24  make sure it will not exceed EOF (D815)
  EC29  else, error >>EC11
  EC2C  ---

         *** STILL IN SAME DATA BLOCK? ***

  EC32  get old mark (FE5A)
  EC35  find its block no. (*2) (D813)
  EC3D  compute distance in pages from old mark's (FE73)
  EC41  block to new mark (FE4E)
  EC47  earlier -- need new data block >>EC58
  EC4B  too far forward -- need new block >>EC58
  EC50  MSB's match? (D814)
  EC55  then mark is still in this block >>ED79

  EC58  check storage type (D807)
  EC5B  zero? >>EC64
  EC5D  seedling, sapling or tree?
  EC61  no, special handling for DIR files >>EDAB

  EC64  This is a bug!!!
        (The immediate addressing mode was used
         where absolute addressing was intended.)
  EC66  This will stomp on another FCB! (D800)
  EC69  return with bad REFNUM error
  EC6C  RETURN

         *** NEED DIFFERENT DATA BLOCK ***

  EC6D  copy storage type (D807)
  EC73  old data block needs writing? (D808)
  EC78  no >>EC7F
  EC7A  yes, do so <EE83>
  EC7D  error? >>ECE8
  EC7F  see if new mark is outside the range of (FE5A)
  EC82  the current index block (D814)
  EC91  yes >>ECB1
  EC95  yes >>ECB1
  EC97  no, same index block (FE5E)
  EC9A  check storage type
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EC9B
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EC9B  sapling or tree are ok >>ED16

          *** SEEDLING ***

  EC9D  seedling, check position (FE73)
  ECA0  if position is outside of block 0..
  ECA4  promote to sapling >>ED04
  ECA6  else, (D80C)
  ECAE  go get key block (seedling data block) >>ED6F

          *** NEED TO CHANGE DATA BLOCKS ***

  ECB1  does old index block need dumping? (D808)
  ECB6  no >>ECBD
  ECB8  yes, do so <EE97>
  ECBB  error? >>ECE8
  ECBD  check storage type (FE5E)
  ECC0  tree file?
  ECC2  yes >>ECE9
  ECC4  no, sapling (FE74)
  ECC9  is position in first index block?
  ECCC  no, need master index, subindex and data >>ED2F
  ECCE  yes, first index, reset flags <ED9F>
  ECD1  is this a seedling?
  ECD2  if so, see if in first block >>EC9D

          *** SAPLING ***

  ECD4  no, sapling, read its only index block <EE2A>
  ECD7  error? >>ECE8
  ECDC  set block no. of index block
  ECE6  Always branch >>ED16

  ECE8   Error exit

          *** TREE FILE/NEED ANOTHER INDEX BLOCK ***

  ECE9  reset flags <ED9F>
  ECEC  read master index block <EE2A>
  ECEF  error? >>ECE8
  ECF1  make index into block from (FE74)
  ECF4  MSB_of_position/2
  ECFA  is there a subindex there?
  ECFC  yes! >>ED09
  ED02  no, fall thru to make one

          *** GET NEW INDEX BLOCK ***
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: ED04
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------


  ED04  need an index and data block
  ED06  go allocate them >>ED2F

  ED09  set up block no. of subindex
  ED11  read it <EE0D>
  ED14  error? >>ECE8

          *** SAPLING/TREE - THIS INDEX BLOCK ***

  ED16  make block no. out of position (FE74)
  ED1F  use as an index to examine index block
  ED21  entry
  ED27  if its zero...
  ED2B  need new data block
  ED2F  set flags for what to allocate (FE5A)
  ED38  new index block being created?
  ED3A  zero data block in any case <ED57>
  ED3D  if not index block that's it >>ED79
  ED3F  Zero the Index Block I/O Buffer <ED45>
  ED42  and continue >>ED79

ED45 ********* ZERO INDEX BLOCK I/O BUFFER ***************************

  ED45  ---
  ED48  Zero first page
  ED4F  and second page of Index Block I/O buffer
  ED54  Restore pointer to beginning of buffer
  ED56  RETURN

ED57 ********* ZERO OUT DATA BLK I/O BUFFER ***************************

  ED57  ---
  ED5A  Zero first page
  ED61  and second page of data block I/O buffer
  ED66  Restore pointer to beginning of buffer
  ED68  RETURN

ED69 ********* READ FILE DATA BLOCK **********************************

  ED69  set block no. LSB
  ED6B  copy MSB drom index entry
  ED6F  ---
  ED71  read new data block <EDF4>
  ED74  error? >>ED9E
  ED76  reset block allocation flags <ED9F>
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: ED76
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

        *** GOT DATA BLOCK WANTED ***

  ED79  ---
  ED80  save previous mark in my variables (D812)
  ED86  set new mark in the FCB (FE72)
  ED91  ($4A/$4B --> data block buffer)
  ED93  $4C/$4D --> start of the page in
  ED95  the data block buffer which contains (FE73)
  ED98  the mark.
  ED9E  exit

ED9F ********* RESET BLOCK ALLOC FLAGS *******************************

  ED9F  get flags (FE5A)
  EDA5  turn off low 3 bits (allocate no new
  EDA7  blocks to file) (D808)
  EDAA  RETURN

EDAB ********* SET DIR FILE POSITION *********************************

  EDAB  DIR file?
  EDAD  yes! >>EDB4
  EDAF  no, bad storage type error
  EDB1  go to SYSERR <BF09>
  EDB4  else, get page distance (FE4E)
  EDB7  make it into blocks (divide by 2)
  EDBE  new position beyond old? (FE73)
  EDC1  yes >>EDD1
  EDC3  else, use previous mark
  EDC5  copy to BLKNUM <EDDF>
  EDC8  error? >>EDEE
  EDCA  count it (FE62)
  EDCD  more to skip? >>EDC3
  EDCF  no, got it >>ED79
  EDD1  use next_block pointer in DIR block
  EDD3  copy to BLKNUM <EDDF>
  EDD6  error? >>EDEE
  EDD8  count it (FE62)
  EDDB  more to skip >>EDD1
  EDDD  got it now! >>ED79

        *** COPY LINK TO BLKNUM ***

  EDDF  copy block number link
  EDE1  to BLKNUM
  EDE4  if non zero,
  EDEA  then go read block. >>EDF0
  EDEC  else, EOF error
  EDEE  ---
  EDEF  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EDEF
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

EDF0 ********* READ FILE BLOCK ***************************************

  EDF0  set block number to read
  EDF4  store read I/O command
  EDF8  read to $48/$49 buffer
  EDFA  read the block <EE50>
  EDFD  error? >>EE0C
  EE02  copy block no. just read to FCB
  EE0C  exit

EE0D ********* READ SUB-INDEX BLOCK **********************************

  EE0D  set read I/O command
  EE11  read to $48/$49 buffer
  EE13  read the block <EE50>
  EE16  error? >>EE26
  EE1B  save BLKNUM in FCB as current index
  EE1D  block. (D80E)
  EE26  exit

EE27 ********* WRITE KEY INDEX BLOCK **********************************

  EE27  set write I/O command
  EE29  Use bit instruction to skip over two bytes

EE2A ********* READ KEY INDEX BLOCK ***********************************

  EE2A  ---

EE2C ********* READ OR WRITE KEY INDEX BLOCK **************************

  EE2C  save command
  EE2F  block no. is key block in FCB (FE5A)
  EE34  use $48/$49 buffer

        *** I/O BLOCK ***

  EE36  set I/O command
  EE38  and block no. (D800)
  EE42  must be non-zero block number
  EE46  or horrible death!
  EE4B  fall through to read/write block (D801)

        *** SET UP AND DO FILE BLOCK I/O ***

  EE50  (xreg = buff ptr in zero page)
  EE51  disable
  EE52  set up buffer pointer
  EE5D  get DEVNUM from FCB (D801)
  EE63  set I/O transfer has occurred flag
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EE68
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EE68  set unit no. from DEVNUM (BF30)
  EE6D  no errors have occurred yet
  EE72  do block I/O <DEE4>
  EE75  error? >>EE7A
  EE77  no, exit normally
  EE79  RETURN

  EE7A  else, exit with error
  EE7C  RETURN

EE7D ********* CHECKPOINT BITMAP & KEY BLOCK ************************

  EE7D  checkpoint bitmap buffer <EB76>
  EE80  go write key block for file >>EE27

EE83 ********* CHECKPOINT DATA BLOCK BUFFER *************************

  EE83  buffer pointer at $4A/$4B
  EE85  point to block no. in FCB
  EE8D  go write buffer to disk <EE36>
  EE90  error? >>EEB4
  EE94  go turn off $40 flag in FCB and exit >>EEAB

EE97 ********* CHECKPOINT INDEX BLOCK BUFFER ************************

  EE97  checkpoint volume bitmap <EB76>
  EE9A  use $48/$49 buffer
  EE9C  block no. is current index block in FCB
  EEA2  set to write
  EEA4  go write it to disk <EE36>
  EEA7  error?  >>EEB4
  EEA9  no longer needs checkpoint
  EEAB  set flags accordingly (FE5A)
  EEB4  and exit

EEB5 *************************************************************
         ****** MLI OPEN CALL ******
         **************************

  EEB5  search path for file <E593>
  EEB8  found it? >>EEBE
  EEBA  no, bad path error
  EEBC  exit >>EEC5
  EEBE  else, see if FCB already open on file <EF9B>
  EEC1  for write. if not, continue. >>EECB
  EEC3  else, file already open error
  EEC5  ---
  EEC6  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EEC6
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EEC7  Error -- unsupported storage type
  EECA  RETURN

  EECB  get FCB index (FE5A)
  EED1  free FCB found? >>EED7
  EED3  no, all FCB's in use error
  EED6  RETURN

  EED7  zero out unused FCB
  EEE2  copy file ID fields to FCB
  EEE5  (DEVNUM, DIR HDR BLK, DIR BLK, (FE5A)
  EEE8  DIR ENTRY NO.)
  EEF3  isolate storage type (FE27)
  EEFB  and copy to FCB (D807)
  EEFE  get access (FE45)
  EF03  DIR file?
  EF05  no >>EF09
  EF07  yes, we are only reading (I hope)
  EF09  update access flag in FCB (D809)
  EF0E  write protected? >>EF15
  EF10  no, another FCB open on this file? (FE5F)
  EF13  yes, no touchie >>EEC3

  EF15  storage type must be < $4
  EF19  or equal to $D
  EF1B  else, storage type error >>EEC7
  EF1D  ---
  EF1F  copy key block, blocks used, and
  EF21  EOF mark to FCB (FE5A)
  EF31  BLKNUM = key block number
  EF36  store REFNUM in FCB (FE62)
  EF3C  go check and assign I/O buffer <FBB1>
  EF3F  error? >>EF65
  EF41  go find VCB and set buff ptrs <E1E2>
  EF44  set current level in FCB (BF94)
  EF4A  seedling, sapling or tree? (D807)
  EF4F  no, skip next stuff >>EF7C
  EF51  yes, make current mark in FCB outside
  EF53  first index block to force a read of all (D814)
  EF56  index blocks and BLOCK 0.
  EF5A  zero mark wanted, however (FE72)
  EF60  go set mark to zero <EC32>
  EF63  ok? >>EF81
  EF65  no, save the error code
  EF69  got and I/O buffer? (D80B)
  EF6C  no >>EF74
  EF6E  yes, free it <FC0E>
  EF74  mark FCB not in use
  EF7A  exit with error
  EF7B  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: EF7B
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EF7C  else, read key block to I/O buffer <EDF4>
  EF7F  error? >>EF65
  EF81  bump open file count in VCB (FE59)
  EF87  indicate files are open in VCB (D911)
  EF8F  put REF NUM in caller's parmlist (FE5A)
  EF99  exit with no errors
  EF9A  RETURN

EF9B ********* FIND A FCB ***************************************************

  EF9B  clear flags and index byte
  EFA6  ---
  EFA7  found a free FCB yet? (FE5B)
  EFAA  yes >>EFAF
  EFAC  no, bump entry count (FE62)
  EFAF  FCB in use? (D800)
  EFB2  yes >>EFC1
  EFB4  no,
  EFB7  save index to free FCB (FE5A)
  EFBA  flag that we found one
  EFBF  and skip this FCB >>EFDF
  EFC1  ---
  EFC7  compare file ID's to see if this FCB (D800)
  EFCA  is open on the requested file. (FE20)
  EFCD  no match? >>EFDF
  EFD3  indicate FCB already open on file (FE5F)
  EFD6  write enabled? (D809)
  EFDB  if not, allow multiple open access to file >>EFDF
  EFDD  else, error exit
  EFDE  RETURN

  EFDF  return index to start of FCB
  EFE3  bump to next FCB
  EFE5  and loop >>EFA6
  EFE7  when done, exit normally
  EFE8  RETURN

EFE9 *************************************************************
          ****** MLI READ CALL ******
          **************************

  EFE9  point to data buffer <F1F5>
  EFEC  copy request length <F1DA>
  EFEF  save access
  EFF0  set up marks <F207>
  EFF4  read access permitted?
  EFF6  yes >>EFFC
  EFF8  no, access error
  EFFC  will we read past EOF? >>F023
  EFFE  yes, (FE5A)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F001
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F001  LENGTH = EOF - current_mark (D815)
  F019  are we already at EOF? (FEA2)
  F01C  no >>F02E
  F01E  yes, EOF error

  F023  else, zero length request? (FEA2)
  F029  no >>F02E
  F02B  yes, set mark and exit >>F0E1

  F02E  validity check data buffer <FC46>
  F031  no good? >>F020
  F033  ok, get storage type for file <F200>
  F036  standard kind of file?
  F038  yes >>F03D
  F03A  no, DIR file >>F1A3

  F03D  else, set mark (to read proper buffers) <EC32>
  F040  error? >>F020
  F042  set up buffer indexing <F0F8>
  F045  move all that can be moved out of data buff <F122>
  F048  newline or len=0: exit now! >>F02B
  F04A  newline enabled? continue block by block >>F03D
  F04C  at least 1 block's worth left to be read? (FE76)
  F050  if not, never mind >>F03D
  F052  if so, store block count wanted (FE77)
  F055  get FCB flags <F5D6>
  F058  data block modified?
  F05A  yes, continue block by block for now >>F03D

          *** FAST DIRECT READ ROUTINE ***

  F05C  signal no read occurred yet (FE7A)
  F05F  read directly into caller's data buffer
  F067  set mark/read data block to caller's buff <EC32>
  F06A  error? >>F0D5
  F06C  bump buffer pointer to next location
  F070  drop length remaining by 512 bytes (FE76)
  F076  bump mark (FE73)
  F07E  and mark's MSB as necessary (FE74)
  F081  check if we are out of index block (FE74)
  F087  drop counter of multi-blocks (FE77)
  F08A  and keep on >>F099
  F08C  end of multi-block read, put ptrs back <F195>
  F08F  more to read? (FE75)
  F095  no, exit through finish-up >>F0E1
  F097  yes, conventional block by block read then >>F03D
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F097
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F099  crossed index block? go do set mark >>F067
  F09B  make index block offset from mark (FE74)
  F0A4  BLKNUM = next block in index block
  F0AA  zero entry?
  F0B2  if so, no direct read can occur until next (FE7A)
  F0B5  set-mark/read >>F0BA
  F0B7  get MSB of BLKNUM
  F0BA  (put index ptr back)
  F0BE  finish setting BLKNUM MSB
  F0C0  if no read occurred within setmark, (FE7A)
  F0C3  go back to setmark call >>F067
  F0C7  disable
  F0C8  do I/O to caller's buffer directly
  F0CC  do block I/O directly <DEE4>
  F0CF  error? >>F0D4
  F0D2  go back for more >>F06C

          *** ERROR CLEANUP ***

  F0D4  ---
  F0D5  ---
  F0D6  set buffer ptrs/VCB <F195>
  F0DA  ---
  F0DB  finish up I/O <F0E1>
  F0DF  exit with error
  F0E0  RETURN

F0E1 ********* I/O FINISH UP ***************************************

  F0E1  ---
  F0E4  return actual length read in caller's list (FEA2)
  F0F5  and exit by setting new mark >>EC32

F0F8 ********* SET UP BUFFER INDEXING *******************************

  F0F8  ---
  F0FC  back up pointer to data buffer by an
  F0FE  amount equal to the LSB of the mark (FE72)
  F101  (which makes indexing easier)
  F107  newline mode enabled? (D81F)
  F10B  no, CLC >>F117
  F10D  yes, SEC
  F10E  copy newline mask (FE79)
  F111  and newline character (D80A)
  F117  first char index is LSB of mark in YREG (FE72)
  F11A  $4C/$4D --> page containing mark
  F11E  request count LSB in XREG (FE75)
  F121  exit
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F121
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

F122 ********* COPY FROM I/O BLOCK BUFF ******************************
          ****** TO DATA BUFFER           ******
          EXITS IF:   LENGTH GOES TO ZERO
                      NEXT BLOCK IS NEEDED
                      NEWLINE IS FOUND
          ON EXIT: OVERFLOW FLAG SET IF DONE
                   OVERFLOW ZERO IF NEXT BLOCK NEEDED

  F122  ---
  F123  partial page to move? >>F12D
  F125  no, any full pages left? (FE76)
  F128  no, read complete >>F17C
  F12A  yes, drop MSB of request length (FE76)
  F12D  ---
  F12E  copy one byte $4C --> $4E
  F132  check for newline if carry set >>F165
  F134  ---
  F135  end of requested chunk >>F150
  F137  ---
  F139  more bytes to copy >>F12E
  F13B  end of page, bump pointers
  F13F  bump new mark (FE73)
  F147  finished first page of block buffer?
  F14B  if so, continue >>F12E
  F14E  no, need another block from disk  >>F17F
  F150  another page in request length? (FE76)
  F153  no >>F16F
  F156  more in this block-page? >>F15E
  F158  no, on last page of block?
  F15C  no >>F161
  F15E  yes, drop request len by one page (FE76)
  F161  back up to next byte again
  F162  go copy next page >>F137

  F165  check for newline
  F16D  not it, never mind! >>F134
  F16F  else, were we done with page?
  F170  no >>F17C
  F172  yes, bump pointer
  F174  and mark (FE73)
  F17C  set overflow flag (read completed) (F194)

  F17F  update mark LSB (FE72)
  F184  bump request count if necessary
  F185  update count LSB (FE75)
  F18B  point beyond data in caller's buffer
  F193  ---
  F194  and exit
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F194
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

F195 ********* CLEANUP AFTER DIRECT I/O *****************************

  F195  restore caller's data buffer pointer
  F1A0  go set buffers/find VCB and exit >>E1E2

F1A3 ********* DIRECTORY FILE READ ***********************************

  F1A3  set mark/read <EC32>
  F1A6  error? >>F1D7
  F1A8  set up buffer indexing <F0F8>
  F1AB  move data from I/O buffer <F122>
  F1AE  need next block? >>F1A3
  F1B0  no, finish up I/O <F0E1>
  F1B3  ok? exit >>F1D5
  F1B5  not ok. EOF error?
  F1B8  no, out now >>F1D6
  F1BA  yes, point beyond EOF anyway? <ED79>
  F1BD  zero out data block I/O buffer <ED57>
  F1C5  dummy up an empty DIR block with previous (D810)
  F1C8  pointer and no forward pointer in I/O
  F1CA  buffer.
  F1CC  zero out current block no. (D810)
  F1D5  return to caller
  F1D6  RETURN

  F1D7  finish up and error exit >>F0DA

F1DA ********* COPY CALLER'S I/O LENGTH ******************************

  F1DA  copy request length to LENGTH and
  F1DC  a temporary variable
  F1ED  pick up ACCESS flcgs for file (FE5A)
  F1F3  exit to caller
  F1F4  RETURN

F1F5 ********* POINT $4E/$4F TO CALLER'S ******************************
          ****** DATA BUFFER                ******

  F1F5  set up pointer
  F200  YREG --> FCB (FE5A)
  F203  AREG = storage type (D807)
  F206  exit

F207 ********* COPY FILE MARK AND COMPUTE *****************************
          ****** AND COMPARE END MARK       ******
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F207
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F207  ---
  F20D  copy file mark (D812)
  F213  and set previous mark also (FE55)
  F216  add length giving new mark in scratch area (FEA2)
  F21D  (3 byte addition)
  F225  will new mark exceed EOF? (FE4E)
  F233  return with carry set accordingly

F234 ********* SET NEW MARK & EOF ************************************

  F234  set up indexes <F266>
  F237  set new EOF in FCB (FE52)
  F23D  and new mark (FE55)
  F243  save new mark in scratch variable too (FE4E)
  F24A  does mark exceed EOF? <F266>
  F24D  if so, we must extend EOF <F225>
  F253  save old EOF (D815)
  F25B  set new EOF to mark if necessary (FE4E)
  F261  ---
  F265  exit

  F266  subroutine to set 3 byte indexes
  F26D  RETURN

F26E ************************************************************************
          ****** MLI WRITE CALL ******
          ****************************

  F26E  copy request length <F1DA>
  F272  copy file mark <F207>
  F275  extend EOF if needed <F250>
  F279  write access enabled?
  F27B  yes >>F281
  F27D  no, access error
  F281  check status of this device <F431>
  F284  error? >>F2C1
  F286  request length = 0? (FEA2)
  F28C  no  >>F291
  F28E  yes, exit through finish-up >>F0E1

  F291  find caller's data buffer <F1F5>
  F294  check storage type
  F296  if DIR file, error >>F27D
  F298  set mark/read blocks <EC32>
  F29B  error? >>F2C1
  F29D  get FCB flags <F5D6>
  F2A0  any new blocks needed?
  F2A2  no >>F306
  F2A4  yes, allocating them
  F2A6  ---
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: F2A7
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  F2A7  count number of blocks needed
  F2AA  store number needed (FE5C)
  F2B0  see if the blocks are available <E959>
  F2B3  no, disk full >>F2C1
  F2B5  yes, get FCB flags <F5D6>
  F2B8  master index block needed?
  F2BA  no >>F2C9
  F2BC  yes, go add it <F381>
  F2BF  and go on if no errors >>F2D5

  F2C1  error,
  F2C2  set new mark/EOF <F234>
  F2C6  and finish I/O, exit with error >>F0DA

  F2C9  check FCB flags again <F5D6>
  F2CC  need sub-index block?
  F2CE  no >>F2D5
  F2D0  yes, go do it <F3BD>
  F2D3  error? >>F2C1
  F2D5  buy a new block for data <F411>
  F2D8  error? >>F2C1
  F2DA  get FCB flags <F5D6>
  F2DD  indicate index buffer changed
  F2DF  no new blocks needed now
  F2E1  update FCB dlags (D800)
  F2E7  make index block offset from mark
  F2EF  store new block no. in index block (FE4F)
  F2FC  and store it as current data block (FE5A)
  F306  set up buffer indexing <F0F8>
  F309  start writing <F311>
  F30C  go see if more blocks are needed >>F298
  F30E  I/O finish up when done  >>F0E1

F311 ********* COPY WRITE DATA TO I/O BLOCK **************************

  F311  ---
  F314  lower request count by 1 (FE76)
  F31C  ---
  F31D  copy partial page from caller's data
  F31F  to I/O block buffer
  F324  ---
  F327  next page in caller's area
  F32B  bump mark by $100 (FE73)
  F333  still in same I/O block page?
  F337  yes >>F31C
  F33A  no, clear overflow (I/O incomplete) >>F361
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: F33A
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  F33C  any complete pages left to write? (FE76)
  F33F  no >>F351
  F341  yes, more in this page?
  F342  yes >>F34A
  F344  no, first block-page?
  F348  no >>F34D
  F34A  yes, one less complete page to do (FE76)
  F34D  readjust index
  F34E  continue with full page >>F324

  F351  ---
  F352  a few bytes left to write? >>F35E
  F354  no, bump data buffer by $100
  F356  and mark (FE73)
  F35E  set overflow (I/O complete) (F194)
  F361  store LSB of mark (FE72)
  F364  and of request count (FE75)
  F368  indicate data block modifed <F5D6>
  F36B  and DIR entry needs update
  F371  advance pointer into caller's buffer (FE72)
  F37C  set FCB flag to indicate write occurred <FA2C>
  F380  exit

F381 ********* ADD NEW MASTER INDEX BLOCK ****************************
          (MAKE A TREE FILE)

  F381  add higher level <F3CA>
  F384  error? >>F3C9
  F386  get storage type <F200>
  F389  tree?
  F38B  yes >>F392
  F38D  no, add another level <F3CA>
  F390  error? >>F3C9
  F392  buy another block <F411>
  F395  error? >>F3C9
  F397  maie offset into current index block (FE74)
  F39A  from current mark
  F39C  point index to new block (FE4E)
  F3AB  also save as current data block (FE5A)
  F3B5  checkpoint bitmap & key block <EE7D>
  F3B8  error >>F3C9
  F3BA  Zero out new index block >>ED45

F3BD ********* ADD NEW INDEX BLOCK ***********************************

  F3BD  check storage type <F200>
  F3C2  seedling? >>F3CA
  F3C4  no, read key index block <EE2A>
  F3C7  and go add data block >>F392
  F3C9  exit if error occurs
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F3C9
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

         *** ADD A HIGHER INDEX LEVEL TO FILE ***

  F3CA  buy a block <F411>
  F3CD  error? >>F410
  F3D2  save old key block number (D80C)
  F3DA  make new block the key block (D80C)
  F3E7  and current index block in FCB (D80F)
  F3F0  store pointer to old key block
  F3F3  in first position of new index
  F3FA  checkpoint bitmap and new key block <EE7D>
  F3FD  error? >>F410
  F3FF  get storage type <F200>
  F404  upgrade it to next higher type (D807)
  F407  indicate DIR entry needs update (D808)
  F410  exit

F411 ********* BUY A DISK BLOCK ************************************

  F411  allocate a disk block <EA9C>
  F414  error? >>F430
  F416  get FCB flags <F5D6>
  F419  indicate DIR entry needs update
  F422  add 1 to blocks in use for file
  F42F  ---
  F430  exit

F431 ********* DO STATUS IF NO I/O YET ******************************

  F431  get FCB flags <F5D6>
  F434  any buffers in use? (I/O activity)
  F436  if so, assume its ok >>F42F
  F438  no, (D801)
  F43B  select new device (BF30)

         *** STATUS CALL ***

  F43E  Save Unit Number
  F440  Save Block Number on stack
  F446  Indicate Status call
  F44A  Indicate Block 0
  F44E  Go do I/O <DEE4>
  F451   Restore Block Number to original value
  F459   Exit
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F45A
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

F45A ************************************************************
         ****** MLI CLOSE CALL ******
         ****************************

  F45A  check REF NUM
  F45E  specific close? >>F494

         *** CLOSE ALL OPEN FILES ***

  F460  no errors yet (FE89)
  F465  store FCB index (FE5D)
  F469  get its level (D81B)
  F46C  if below system LEVEL, skip it (BF94)
  F46F  yes, skip it >>F486
  F471  no, active FCB? (D800)
  F474  no >>F486
  F476  yes, flush it and update directory <F4F2>
  F479  error? >>F4C7
  F47B  no, close specific FCB <F499>
  F480  is this a close-all?
  F482  yes, ignore errors >>F486
  F484  no, stop on error >>F4C7
  F486  bump FCB index to next one (FE5D)
  F48C  and continue >>F465
  F48E  when all FCBs checked, load error number (FE89)
  F491  no error  >>F4C5
  F493  error exit

         *** CLOSE SPECIFIC FILE ***

  F494  flush it <F4FA>
  F497  error? >>F4C7
  F499  get buffer number (FE5D)
  F49F  free its pages <FC11>
  F4A2  error? >>F4C7
  F4A4  release FCB
  F4AC  set DEVNUM (D801)
  F4B2  find VCB for device <E859>
  F4B5  decrement count of open files in VCB (FE5C)
  F4BB  some are open... >>F4C5
  F4BD  if all are closed, turn off (D911)
  F4C0  "files open" flag
  F4C5  ---
  F4C6  exit

  F4C7  Branch to handle close error >>F4F7
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F4C7
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

F4C9 ************************************************************
         ****** MLI FLUSH CALL ******
         ****************************

  F4C9  flush specific file?
  F4CD  yes >>F4FA
  F4CF  no, clear flush-all error code (FE89)
  F4D2  do all FCBs
  F4D4  set FCB index for next FCB (FE5D)
  F4D8  is this file open? (D800)
  F4DB  no >>F4E2
  F4DD  yes, flush it <F4F2>
  F4E0  error? >>F4F7
  F4E2  bump to next FCB (FE5D)
  F4E8  and go flush it too >>F4D4
  F4EA  ---
  F4EB  return with error code if any (FE89)
  F4F1  RETURN

F4F2 ********** FLUSH A FILE & UPDATE DIRECTORY **********************

  F4F2  find buffer/VCB <E1E2>
  F4F5  no error? >>F504
  F4F7  go handle close error >>F5C7

  F4FA  zero out close-all error
  F4FF  validity check REF NUM <E1C7>
  F502  error? >>F4F7
  F504  is write access allowed? (D809)
  F509  no, exit >>F4EA
  F50B  has a write occured since last flush? (D81C)
  F50E  yes >>F517
  F510  no, <F5D6>
  F513  does anything need flushing anyway?
  F515  no, then exit now >>F4EA
  F517  else, get FCB flags <F5D6>
  F51A  has data buffer changed?
  F51C  no >>F523
  F51E  yes, checkpoint it <EE83>
  F521  error? >>F4F7
  F523  get flags again <F5D6>
  F526  has index buffer changed?
  F528  nm >>F52F
  F52A  yes, checkpoint it <EE97>
  F52D  error? >>F4F7
  F52F  ---
  F536  copy file identifier data to my variables (D800)
  F540  set DEVNUM (BF30)
  F543  BLKNUM = current DIR block (FE25)
  F549  read DIR block <EBC9>
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F54C
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F54C  error? >>F4F7
  F54E  copy directory header <E695>
  F551  are we in block with this file's entry? (FE27)
  F55A  no >>F561
  F55F  yes >>F568
  F561  no, set new block number
  F565  read it <EBD9>
  F568  point at directory entry in block <E499>
  F56B  copy file entry from directory <E598>
  F571  copy blocks used count to entry (D818)
  F57F  copy new EOF (D815)
  F58A  and new key block no. (D80C)
  F593  isolate new storage type (D805)
  F59D  combine it with name length (FE2A)
  F5A5  and update type/len field in entry (FE2A)
  F5A8  write entry back to directory <E4B2>
  F5AB  error? >>F5C7
  F5B0  turn off "write occurred" flag (D81C)
  F5B8  same bitmap in memory (FE24)
  F5BE  no, exit now >>F5C5
  F5C0  yes, checkpoint it also <EB76>
  F5C5  no errors, exit
  F5C6  RETURN

F5C7 ********** CLOSE ERROR ***************************************

  F5C7  is this a close or flush all?
  F5CC  no >>F5D4
  F5D0  yes, save error code (FE89)
  F5D3  RETURN

  F5D4  else, real error right now
  F5D5  RETURN

F5D6 ********** GET FCB FLAGS ************************************

  F5D6  load FCB flags (FE5D)
  F5D9  from FCB (D808)
  F5DC  and exit

F5DD ********** FILE ACCESS ERROR ********************************

  F5DD  exit with file access error code
  F5E0  RETURN

F5E1 ************************************************************
         ****** MLI SET_EOF CALL ******
         ******************************
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F5E1
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F5E1  get storage type <F200>
  F5E4  if DIR file...
  F5E6  its an access error >>F5DD
  F5E8  else, save type for truncate to
  F5E9  mess with.
  F5EF  write access permitted? (D809)
  F5F4  no, error >>F5DD
  F5F6  check device status <F431>
  F5F9  error? >>F5DD
  F602  copy EOF from FCB (D815)
  F610  copy caller's new EOF
  F61B  compare old EOF to new (FE55)
  F621  if less than or equal to... >>F628
  F623  if greater... >>F63D

          *** OLD EOF <= NEW EOF ***
          *** NO TRUNCATE NEEDED ***

  F628  new eof beyond old
  F62F  copy caller's EOF to FCB
  F63A  exit by indicating flush needed >>FA2C

          *** OLD EOF > NEW EOF ***
          *** TRUNCATE FILE     ***

  F63D  flush first <F4FA>
  F640  error? >>F5E0
  F642  $43/$49 --> end of data block I/O buffer
  F64C  compare current mark to new EOF (FE5D)
  F659  it is prior to EOF >>F672
  F661  if past EOF, force mark back to EOF (FE5D)
  F672  construct EOF block number and (FE75)
  F675  byte offset into block from new (FE91)
  F678  EOF mark. (FE76)
  F690  on a block boundary? (FE92)
  F693  yes >>F6B2
  F695  no, (FE90)
  F699  decrement block by 1
  F6A7  but don't let it fall below 0
  F6B2  copy key block number (FE5D)
  F6C1  set blocks freed to zero
  F6C9  truncate file at new EOF <FA3E>
  F6CC  save status
  F6D4  set new key block in FCB (FE8A)
  F6DA  drop FCB block count by number (D818)
  F6DD  of blocks freed in truncate routine.  (FE8D)
  F6EA  copy new storage type (FE8C)
  F6F7  turn off all block allocation flags <ED9F>
  F6FA  update VCB free block count <F9BD>
  F704  copy mark (D812)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F70C
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F70C  force current mark to infinity (D812)
  F713  go set mark <EC32>
  F716  no errors? >>F71F
  F718  if error, indicate in saved status
  F71E  but continue
  F71F  copy caller's EOF to FCB <F628>
  F722  Flush and update <F4FA>
  F725  no errors? >>F72E
  F727  if error, indicate in saved status
  F72D  but continue
  F72E  ---
  F730  exit

F731 ************************************************************************
          ****** MLI GET_EOF CALL ******
          ******************************

  F731  ---
  F736  copy EOF to caller's list (D815)
  F742  exit -- no errors

F743 ************************************************************************
          ****** MLI NEW_LINE CALL ******
          ******************************

  F743  ---
  F745  copy newline mask
  F74E  and newline character
  F754  return, no errors

F755 ************************************************************************
          ****** MLI GET FILE INFO CALL ******
          ***********************************

  F755  get the file entry <E593>
  F758  ok? >>F79C
  F75A  no, bad path?
  F75D  no, real error >>F7B9
  F75F  else, make it VOL DIR type
  F761  with name length = 0 (FE2A)
  F766  no free blocks needed (FE5F)
  F76C  go through the motions to update the (FE5C)
  F76F  VCB block count. <E964>
  F775  copy blocks free from VCB (D915)
  F781  copy total blocks on volume to AUX_ID (D913)
  F78F  total - free = blocks_used (FE5F)
  F79C  shift type down from high nibble (FE2A)
  F7A8  copy the data to caller's parmlist (FDD7)
  F7B9  and exit
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F7B9
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

F7BA ************************************************************
         ****** MLI SET FILE INFO CALL ******
         ************************************

  F7BA  get the file entry <E593>
  F7BD  error? >>F7E4
  F7BF  indicate backup needed now (BF95)
  F7CE  copy 13 parms from caller's list to (FDD7)
  F7D1  file entry staging area >>F7D8
  F7D8  ---
  F7DD  if any spurious access bits are on...
  F7E1  access error!
  F7E4  RETURN

  F7E5  else, anything in his modification date?
  F7E9  no >>F7EE
  F7EB  yes, go update directory >>E4C2

  F7EE  no, use system date then update directory >>E4B2

F7F1 ************************************************************
         ****** MLI RENAME CALL ******
         ****************************

  F7F1  follow path to file <E5A6>
  F7F4  ok? >>F833
  F7F6  no, bad name?
  F7F8  no, real error >>F812

         *** RENAME VOLUME ***

  F7FA  yes, copy new name <F917>
  F7FD  error? >>F812
  F7FF  get first length (D700)
  F803  get next (D700)
  F806  bad path if more than one name for vol  >>F887
  F80B  files open on volume? (D911)
  F80E  no, continue >>F814
  F810  yes, file open error
  F812  ---
  F813  RETURN

  F814  make type/len for a VOL DIR HDR
  F81B  write new name to VOL HDR <F908>
  F81E  error? >>F889
  F825  copy new name to device's VCB (D700)
  F831  exit, no errors
  F832  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F832
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

         *** RENAME FILE ***

  F833  get path index <F925>
  F836  copy old name with prefix to my buffer (D700)
  F842  copy new name to buffer <F917>
  F845  error? >>F889
  F847  get path index <F925>
  F84D  compare all levels of names up to and (DC00)
  F850  including the last. Find first which
  F851  differ.
  F855  save indicies into names which point to (FE84)
  F858  final name. (FE85)
  F85B  ---
  F865  exit if they match completely
  F866  RETURN

  F867  index to differing new name (FE84)
  F86A  point past it (D700)
  F872  must be the last! (D700)
  F875  it isn't >>F887
  F877  it is, (FE85)
  F87A  do the same with the old name  (DC00)
  F885  difference is only in last index? >>F88B
  F887  no, bad path error
  F889  ---
  F88A  RETURN

  F88B  names good. follow path to new file <E5A6>
  F88E  better get an error >>F894
  F890  if found, duplicate name in directory
  F893  RETURN

  F894  if error, better be file not found
  F896  or else its really an error... >>F889
  F898  copy old pathname again <E081>
  F89B  get its file entry <E593>
  F89E  error? >>F889
  F8A0  search FCB's <EF9B>
  F8A5  exit if the file is open for write >>F889
  F8AA  does ACCESS permit rename?
  F8AC  yes >>F8B2
  F8AE  no, access error
  F8B0  ---
  F8B1  RETURN

  F8B2  get type/len from entry (FE2A)
  F8B7  DIR file?
  F8B9  yes, ok >>F8C3
  F8BB  seedling, sapling or tree?
  F8BD  yes, ok >>F8C3
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F8BF
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F8BF  else, compatibility error
  F8C3  copy new path again <F917>
  F8C6  error? >>F889
  F8C8  get length of last name (FE84)
  F8D3  copy it and name to file entry buffer (D700)
  F8E3  combine new len with type (D700)
  F8E9  DIR file?
  F8EB  no, go update entry and exit >>F905
  F8ED  yes, (FE3B)
  F8F3  read key block of this subdirectory  <EBC9>
  F8F6  error? >>F889
  F8FB  copy new name to DIR HDR (D700)
  F900  and update directory's key block <F908>
  F903  error? >>F889
  F905  go update directory entry and exit >>E4C2

F908 ********* COPY PATH TO BUFF & WRITE *****************************

  F908  copy type/len and path to my buffer
  F914  go write the block >>EBD5

F917 ********* POINT TO NEW NAME *************************************
         COPY TO BUFFER

  F917  $48/$49 --> second pathname
  F922  go copy it >>E08C

F925 ********* LOAD PATH INDEX ***************************************

  F925  load pathname index
  F92C  (including prefix if any) (BF9A)
  F92F  ---
  F931  RETURN

F932 ************************************************************************
         ****** MLI DESTROY CALL ******
         ******************************

  F932  get file entry <E593>
  F935  error? >>F97E
  F937  find FCB if any <EF9B>
  F93A  FCB open? (FE62)
  F93D  yes, file open error >>F97C
  F93F  no free blocks needed
  F947  go compute VCB free block count <E959>
  F94A  ok? >>F950
  F94C  error, disk full?
  F94E  no, real error >>F97E
  F950  DESTROY enabled in ACCESS? (FE48)
  F955  yes >>F95C
  F957  no, access error
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: F95C
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  F95C  check status of device  (BF30)
  F962  error? >>F97E
  F964  point to key block (FE3B)
  F973  DIR file?
  F977  no >>F980
  F979  yes, handle differently >>F9D8

  F97C  File open error
  F97E  ---
  F97F  RETURN

          *** DESTROY NON-DIRECTORY FILE ***

  F980  save the storage type (FE8C)
  F987  set EOF to zero (FE8C)
  F98D  byte offset = $200
  F992  "truncate" the file at EOF=0 <FA3E>
  F995  if error >>F97E
  F997  free the key block in volume bitmap (FE8B)
  F9A0  error >>F97E
  F9A2  mark the file as deleted in DIR
  F9A7  decrement file count in DIR (FE1E)
  F9B2  checkpoint volume bit map <EB76>
  F9B5  error >>F97E
  F9B7  update free block count in VCB <F9BD>
  F9BA  and go update the directory >>E4B2

          *** SUBROUTINE TO UPDATE FREE BLOCK ***
          *** COUNT IN VCB                    ***

  F9BD  add blocks freed to total free blocks (FE5C)
  F9C0  in VCB. (FE8D)
  F9D2  start next search for free blocks at
  F9D4  start of bitmap. (D91C)
  F9D7  exit

          *** DESTROY DIRECTORY FILE ***

  F9D8  DIR file?
  F9DA  no, error >>FA27
  F9DC  read volume bitmap block <EB43>
  F9DF  error? >>FA26
  F9E1  BLKNUM = key block pointer (FE3B)
  F9EB  read it <EBD9>
  F9EE  errors? >>FA26
  F9F0  if DIR has any files... (DC25)
  F9FA  access error
  F9FF  write back block marking entry free (DC04)
  FA05  error? >>FA26
  FA07  if "next_pointer" is zero.... (DC02)
  FA11  go back and pretend it's a seedling >>F997
```

```
ProDOS MLI -- V1.2 -- 6 SEP B6                    NEXT OBJECT ADDR: FA13
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FA13  else, (DCØ3)
  FA16  free next block <EA1A>
  FA19  error? >>FA26
  FA1B  BLKNUM = next block (DCØ2)
  FA21  read it <EBC9>
  FA24  if ok, continue in loop >>FAØ7
  FA26  else, error exit

  FA27  incompatible file format error

FA2C ********* SET WRITE OCCURRED FLAG *******************************

  FA2C  save some registers
  FA2F  indicate write occurred (FE5D)
  FA3A  restore registers and exit
  FA3D  RETURN

FA3E ********** TRUNCATE FILE AT EOF *********************************

  FA3E  check storage type*16 (FEBC)
  FA41  seedling?
  FA43  yes >>FA52
  FA45  no, sapling?
  FA47  yes >>FA55
  FA49  no, tree?
  FA4B  yes >>FA5B
  FA4D  General error--wrong storage type
  FA4F  jump to system death <BFØC>

  FA52  go to seedling truncate >>FB24

  FA55  go to sapling truncate >>FAEB

  FA5B  truncate tree,
  FA5A  at most 12B blocks in master index (FE93)
  FA5D  read the master index <FB4F>
  FA6Ø  error? >>FABD
  FA62  at EOF yet? (FE93)
  FA6B  yes >>FABE

          *** FREE WHOLE INDEX BLOCKS AFTER EOF ***
          (free 8 subindex blocks each time the
          master index block is read since we must
          qhare its buffer)

  FA6A  copy up to 8 non-zero index bnock
  FA6C  numbers to (DCØØ)
  FA6F  a handy table (FE95)
  FA8Ø  ---
  FAB9  if there weren't 8 left to do, zero (FE95)
  FABC  remainder of the table (FE9D)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FA92
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FA92  ---
  FA93  update master index counter (FE93)
  FA98  for all 8 entries: (FE94)
  FA9B    set BLKNUM, (FE95)
  FAA3    (exit when a Ø entry is found), >>FA5D
  FAAA    read the sub-index block, <EBD9>
  FAAD    (quit if error), >>FABD
  FAAF    zero all its blocks, <FB7D>
  FAB2    (quit if error), >>FABD
  FABB    and loop until all 8 are done. >>FA98
  FABA  then go back and reread master index >>FA5D
  FABC  normal exit
  FABD  RETURN

  FABE  now go free all the sub-index blocks (FE8F)
  FAC2  which follow EOF <FB7F>
  FAC5  if error >>FABD
  FAC7  write back master index <EBD5>
  FACA  if error >>FABD
  FACC  EOF in first subindex? (FE8F)
  FACF  if so, demote to sapling file >>FAE6
  FAD1  else, BLKNUM = subindex block which (DCØØ)
  FAD4  contains the EOF mark
  FAD9  (exit if none there) >>FABC
  FAEØ  else, read the final subindex block <EBD9>
  FAE3  and treat it as a sapling file >>FAFØ
  FAE5  unless there is an error.

  FAE6  Demote tree to sapling <FB5B>
  FAE9  if error >>FABD

          *** TRUNCATE SAPLING FILE ***

  FAEB  read index block <FB4F>
  FAEE  if error >>FABD
  FAFØ  index of last block in the file (FE9Ø)
  FAF3  add one to point past end of file
  FAF4  if zero, no blocks to free >>FBØØ
  FAF6  zero blocks past EOF <FB7F>
  FAF9  if error >>FABD
  FAFB  write back modified index block <EBD5>
  FAFE  if error >>FABD
  FBØØ  index of last block in file (FE90)
  FBØ3  this index block is empty! >>FB1A
  FBØ5  get BLKNUM of last data block (DCØØ)
  FBØD  (no block allocated?) >>FABC
  FB14  read in last data block <EBD9>
  FB17  and treat it as a seedling file >>FB29
  FB19  unless error occurred.
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FB19
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FB1A  more index blocks (tree file)? (FE8F)
  FB1D  yes, must be tree file >>FB05
  FB1F  no, demote to seedling <FB5B>
  FB22  if error >>FB4E

          *** TRUNCATE SEEDLING FILE ***

  FB24  read key block <FB4F>
  FB27  error? >>FB4E
  FB29  EOF in first page?   (FE92)
  FB2C  yes >>FB34
  FB2E  EOF in second page?
  FB2F  no, exactly 256 bytes >>FB4D
  FB31  get byte offset (FE91)
  FB34  ---
  FB36  zero bytes in second page  (DD00)
  FB3C  EOF in first page? (FE92)
  FB3F  no, we're done. >>FB4A
  FB41  yes, zero bytes in first page, too (FE91)
  FB4A  then write block back and exit >>EBD5

  FB4D  exit normally
  FB4E  RETURN

FB4F ********** READ INDEX BLOCK ************************************

  FB4F  Put index block number in A,X (FE8A)
  FB55  Go read the block >>EBC9

FB5B ********** DEMOTE FILE TO SMALLER FILE TYPE**********************

  FB5B  get high byte of index block (FE8B)
  FB5E  and low byte (FE8A)
  FB61  free the index block in the volume bitmap <EA1A>
  FB64  if error >>FB7C
  FB66  Establish first block of old index block (DC00)
  FB69  as new index block. (FE8A)
  FB73  reduce storage type by one (FE8C)
  FB7B  and exit
  FB7C  RETURN

FB7D ********** FREE ALL BLOCKS IN AN INDEX BLK **********************

  FB7D  ---
  FB7F  save BLKNUM
  FB85  Save Y-register (index within block) (FE68)
  FB90  if it is non-zero....
  FB97  free the block in the volume bitmap <EA1A>
  FB9A  if error >>FBAB
  FB9C  Restore index to Y-reg (FE68)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FB9F
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FB9F  zero this entry
  FBA7  ---
  FBA8  loop through all entries  >>FB85
  FBAB  save error message, if any
  FBAD  restore old BLKNUM
  FBB3  and exit

FBB4 ********** ALLOCATE I/O BUFFER **********************************

  FBB4  ---
  FBB6  get I/O buffer page number
  FBB9  can't be below $800
  FBBB  else, error >>FBFF
  FBBD  can't be above $BC00
  FBBF  else, error >>FBFF
  FBC4  $4A/$4B --> I/O buffer
  FBC8  must be page aligned! >>FBFF
  FBCE  ---
  FBCF  check each page of I/O buffer for <FC3A>
  FBD2  prior allocation in system bit map (BF58)
  FBDF  ---
  FBE0  if ok, mark each page as allocated <FC3A>
  FBE3  in system memory bit map (BF58)
  FBF0  assign buffer number (REFNUM*2) in FCB (D800)
  FBF8  and save buffer location in buffer list
  FBFD  exit
  FBFE  RETURN

  FBFF  bad I/O buffer error
  FC02  RETURN

FC03 ********** LOCATE I/O BUFFER ************************************

  FC03  ---
  FC04  AREG contains buffer number *2 (BF6E)
  FC07  move buffer pointer to NXTBUF variable (FEA8)
  FC10  exit

FC11 ********** FREE I/O BUFFER **************************************

  FC11  is buffer already free? <FC03>
  FC16  yes, exit >>FC38
  FC1A  zero its address in system global page (BF6F)
  FC27  ---
  FC28  free each page in buffer <FC3A>
  FC2B  by marking system bit map
  FC38  exit
  FC39  RETURN
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FC39
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FC3A ********** LOCATE BIT MAP POSITION ******************************
         (GIVEN PAGE NUMBER)

  FC3A  XREG contains page number
  FC3B  compute page number times 8
  FC3E  use as offset for bitmask (FDCB)
  FC45  page number / 8 = byte offset
  FC46  into bitmap
  FC48  exit

FC49 ********** CHECK BUFFER VALIDITY *********************************
                 START > $200    END < $BF00

  FC49  get buffer address (MSB)
  FC4D  must be >$200 else error >>FBFF
  FC4F  get length (FEA6)
  FC55  compute last page no. of buffer
  FC5A  ---
  FC61  may not extend into $BF00
  FC63  else, error >>FBFF

          *** CHECK IF BLOCK OF MEMORY IS FREE ***

  FC66  ---
  FC67  see if this page is allocated <FC3A>
  FC6D  if so, error >>FBFF
  FC6F  else, check other paee also
  FC73  then exit if both have been checked
  FC74  RETURN

FC75 *************************************************************
          ****** MLI GET_BUFF CALL ******
          ******************************

  FC75  get next available buffer
  FC7A  put its address in caller's parmlist
  FC82  and exit
  FC83  RETURN

FC84 *************************************************************
          ****** MLI SET_BUFF CALL ******
          ******************************

  FC84  mark his buffer allocated
  FC89  error? >>FCAB
  FC8B  get old buffer address (FEA9)
  FC95  free old buffer's pages in map <FC20>
  FC9C  copy old buffer contents
  FC9E  to new buffer
  FCAA  then exit
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FCAB
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FCAB  RETURN

FCAC ********* GO TO QUIT CODE HANDLER *******************************

  FCAC  enable 2nd 4K bank of language card (C083)
  FCAF  (Quit code lives at $D100-$D3FF) (C083)
  FCB4  Get first four bytes of page 0,  (0000)
  FCB7  save them on the stack
  FCBB  Set ($00) -> $D100
  FCBD  Set ($02) -> $1000
  FCC9  Set Y = 0
  FCCA  3 pages of code to copy
  FCCC  ---
  FCCD  copy quit code handler to $1000
        The next five lines of code were added for this version (1.2).
        Fortunately they did not survive the next version (1.3).
        Let's hope that whoever wrote this "fancy" code
        is now working for Commodore.
  FCDD  pull 4 saved bytes off stack
  FCDE  and restore them to page 0 (FF04)
  FCE4  enable HIGH RAM BANK1 (C08B)
  FCE7  (MLI) (C08B)
  FCEC  point RESET vector at $1000 (03F2)
  FCF4  set power-up byte properly
  FCF9  go to quit code handler at $1000 >>1000

FCFC ********* ACCESS RAM-BASED DEVICE DRIVER ************************
            This (undocumented?) routine allows a device driver
            to reside in BANK2 of auxiliary high RAM (they normally
            reside in slot ROM).  When the device driver is set up,
            the address of this routine, which may be found at $3EA,
            becomes the address of the device driver.  Bytes $3E4 and $3E5
            are changed to the address of the real driver in aux high RAM.
            This routine must call the page 3 routine at $3D6
            because the MLI is in main high RAM and will be
            swapped out.  The page 3 routine calls the real driver
            and returns here with the error code, if any.

  FCFC  Get current P-reg in accumulator,
  FCFE  then save it on the stack
  FCFF  clear overflow flag
  FD00  interrupts disabled?
  FD02  no >>FD07
  FD04  yes, set overflow flag (FD25)
  FD07  disable interrupts
  FD08  enable RAM, BANK2 (C083)
  FD0E  set carry, indicating error
  FD0F  indicate 6 bytes to move to aux z-page
  FD11  Call real driver thru page 3 routine <03D6>
  FD14  store error number (BF0F)
  FD17  enable RAM, BANK1 (C08B)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FD1D
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FD1D  restore original P-reg
  FD1F  if error number is zero, (BF00)
  FD22  then indicate no error; >>FD25
  FD24  otherwise indicate error
  FD25  RETURN

FD26 ********** INSTALL A SPECIAL IRQ HANDLER ************************
          This routine calls a subroutine located
          at $D400 in BANK2 of high RAM.  It is called when
          an MLI command $42 is executed.  Its purpose
          is to install a routine that handles unclaimed
          interrupts.  Apparently the user has to
          provide the routine at $D400.

  FD26  Switch to BANK2 of high RAM, (C083)
  FD29  execute the program there, <D400>
  FD2C  then back to BANK1 (C08B)
  FD2F   and return.

FD30 ***************************************************************
          *       DATA AREA                 *
          ***********************************

FD30 ********** MLI COMMAND TABLE ************************************
          IN HASH CODE ORDER: IF COMMAND IS...
          ABCD EFGH (IN BINARY BITS)
          INDEX IS COMPUTED AS:
             000D EFGH
            +0000 ABCD

  FD30  GET BUF
  FD31  UNUSED
  FD32  UNUSED
  FD33  UNUSED
  FD34  ALLOC INTERRUPT
  FD35  DEALLOC INTERRUPT
  FD37  UNUSED
  FD38  READ BLOCK
  FD39  WRITE BLOCK
  FD3A  GET TIME
  FD3B  EXIT
  FD3C  CREATE
  FD3D  DESTROY
  FD3E  RENAME
  FD3F  SET FILE INFO
  FD40  GET FILE INFO
  FD41  ON LINE
  FD42  SET PREFIX
  FD43  GET PREFIX
  FD44  OPEN
  FD45  NEWLINE
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FD46
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FD46  READ
  FD47  WRITE
  FD48  CLOSE
  FD49  FLUSH
  FD4A  SET MARK
  FD4B  GET MARK
  FD4C  UNUSED
  FD4D  SET EOF
  FD4E  GET EOF
  FD4F  SET BUF

FD50 ********** PARAMETER COUNT TABLE *********************************

  FD50  GET BUF
  FD51  UNUSED
  FD52  UNUSED
  FD53  UNUSED
  FD54  ALLOC INTERRUPT
  FD55  DEALLOC INTERRUPT
  FD57  UNUSED
  FD58  READ BLOCK
  FD59  WRITE BLOCK
  FD5A  GET TIME
  FD5B  EXIT
  FD5C  CREATE
  FD5D  DESTROY
  FD5E  RENAME
  FD5F  SET FILE INFO
  FD60  GET FILE INFO
  FD61  ON LINE
  FD62  SET PREFIX
  FD63  GET PREFIX
  FD64  OPEN
  FD65  NEWLINE
  FD66  READ
  FD67  WRITE
  FD68  CLOSE
  FD69  FLUSH
  FD6A  SET MARK
  FD6B  GET MARK
  FD6C  UNUSED
  FD6D  SET EOF
  FD6E  GET EOF
  FD6F  SET BUF

FD70 ********** MLI COMMAND ADDRESS TABLE *****************************
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FD70
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FD70  CREATE
  FD72  DESTROY
  FD74  RENAME
  FD76  SET FILE INFO
  FD78  GET FILE INFO
  FD7A  ON LINE
  FD7C  SET PREFIX
  FD7E  GET PREFIX
  FD80  OPEN
  FD82  NEWLINE
  FD84  READ
  FD86  WRITE
  FD88  CLOSE
  FD8A  FLUSH
  FD8C  SET MARK
  FD8E  GET MARK
  FD90  SET EOF
  FD92  GET EOF
  FD94  SET BUF
  FD96  GET BUF

FD98 ********** MLI COMMAND INFO BYTE *********************************

          PATHNAME FLAG
          | REFERENCE NUMBER FLAG
          | | DATETIME STAMP FLAG
          | | |     COMMAND NUMBER
          | | |     |
  FD98    1 0 1   - 00
  FD99    1 0 1   - 01
  FD9A    1 0 1   - 02
  FD9B    1 0 1   - 03
  FD9C    1 0 0   - 04
  FD9D    0 0 0   - 05
  FD9E    0 0 0   - 06
  FD9F    0 0 0   - 07
  FDA0    1 0 0   - 08
  FDA1    0 1 0   - 09
  FDA2    0 1 0   - 0A
  FDA3    0 1 0   - 0B
  FDA4    0 0 1   - 0C
  FDA5    0 0 1   - 0D
  FDA6    0 1 0   - 0E
  FDA7    0 1 0   - 0F
  FDA8    0 1 0   - 10
  FDA9    0 1 0   - 11
  FDAA    0 1 0   - 12
  FDAB    0 1 0   - 13
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FDAB
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FDAC ********** CONSTANTS - DATA AREA *********************************

  FDAC  Blocks Used
  FDAE  End of File
  FDB1  Special ID (Must be 5 bits on)
  FDB2  'HUSTON!'       Author's name
  FDB9  Previous Block of Vol Dir Key Block
          ---
          THE FOLLOWING IS COPIED TO SUBDIR HDR+$20
  FDBB  Version of ProDOS
  FDBC  Minimum Version
  FDBD  Access Byte  (D|Rn|B|000|W|R)
  FDBE  Entry Length
  FDBF  Entries per Block
  FDC0  File Count
  FDC2  Parent LSB (copied to SUBDIR HDR +$20)
          ---
  FDC3  File Type  (Directory)
  FDC4  Block Number
  FDC6  Number of Blocks
  FDC8  End of File

FDCB ********** BITMASK TABLE ***************************************

  FDCB  10000000
  FDCC  01000000
  FDCD  00100000
  FDCE  00010000
  FDCF  00001000
  FDD0  00000100
  FDD1  00000010
  FDD2  00000001

FDD3 ********** OFFSETS INTO FILE CONTROL BLOCKS **********************
FDD3 ***(FCB's are at $D800-$D8FF)***********************************

  FDD3  Key Block

  FDD5  # Blocks Used

  FDD7  End of File

FDDA ********** SET/GET FILE_INFO OFFSETS ****************************

  FDDA  Access
  FDDB  File Type
  FDDC  Aux Type
  FDDE  Storage Type
  FDDF  Blocks Used (MSB on means GET only no SET
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FDE0
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FDE1  Datetime (Last Mod)

  FDE5  Datetime (Creation)

FDE9 ********** FATAL ERROR MESSAGE **********************************

  FDE9  ' INSERT SYSTEM DISK AND RESTART  -ERR Ø '

  FE11  ---

FE11 ********** VARIABLES - DATA AREA *******************************

  FE11  Parent Pointer Block
  FE13  Parent Entry Number
  FE14  Parent Entry Length
  FE15  Datetime (Creation)
  FE19  Version
  FE1A  Min Version
  FE1B  Access Byte
  FE1C  Entry Length
  FE1D  Entries per Block
  FE1E  File Count
  FE20  Bit Map Pointer
  FE22  Total Blocks
          THE FOLLOWING 6 BYTES UNIQUELY IDENTIFY
          A FILE:
  FE24  Device Number
  FE25  Current Directory Block Number (HDR)
  FE27  Block Number of File Entry in Directory
  FE29  File Entry Number in Directory

FE2A ********** FILE ENTRY BUFFER ***********************************

  FE2A  Type/Length  (TTTTLLLL)
  FE2B  File Name (Max 15) >>ØØØF
  FE3A  File Type
  FE3B  Key Pointer
  FE3D  Blocks Used
  FE3F  End of File
  FE42  Datetime (Creation)
  FE46  Version
  FE47  Min Version
  FE48  Access Attribute
  FE49  Aux Type (Load Address/Record Length)
  FE4B  Datetime (Last Mod)
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FE4D
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FE4F  Header Pointer

FE51 ********** Variable Work Area **********************************

  FE51  3 Byte Scratch

  FE54  ---

  FE55  End of File

  FE58  Previous Mark

  FE5B  Compare Vol Name Scratch
  FE5C  Offset into VCB Table ($D900)
  FE5D  Offset into FCB Table ($D800)
  FE5E  Free FCB found Flag

  FE5F  Number of Free Blocks needed

  FE61  Storage Type
          Number of Entries Examined or..
  FE62  FCB already open flag
  FE63  File Count

  FE65  Entries/Block Loop Count/Free FCB's refnum
          Free Entry Found Flag (if > Ø) or..
          # of 1st bitmap block with free bit on or..
  FE66  bit for free
  FE67  # Blocks in Bitmap left to search
  FE68  Y Register temp
  FE69  Pathname Length
  FE6A  Devnum for Prefix Directory Header
  FE6B  Block of Prefix Directory Header
  FE6D  Bitmap Byte Offset in Page
  FE6E  Bitmap Page Offset
  FE6F  Bitmap Buffer Page (Ø or 1)
  FE70  Bitmap Flag (if $8Ø, needs writing)
  FE71  Bitmap DEVNUM
  FE72  Bitmap Block Number
  FE74  Bitmap Block offset for Multiblock Bitmaps

          New Mark to be Positioned to for Set Mark
          or New Moving Mark (for READ)
  FE75  or New EOF for SET_EOF

  FE78  Request Count (Read/Write etc.)
  FE7A  Multi-Block I/O count
  FE7B  Newline character
  FE7C  Newline mask
  FE7D  I/O Transfer occurred flag
```

```
ProDOS MLI -- V1.2 -- 6 SEP 86                    NEXT OBJECT ADDR: FE7E
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  FE7E  MLI Command * 2
  FE7F  ORed into Access Flags ($2Ø - Backup)
  FE8Ø  Duplicate Volume Flag (if $FF)
  FE81  Duplicate Volume's VCB index
  FE82  MLI function code (low 5 bits)
          Characters in current Pathname indx lvl or
  FE83  ONLINE: volname len - loop index
  FE84  new pathname: index to last name
          old pathname: index to last name or..
  FE85  ONLINE: index to data buffer
  FE86  Old PFIXPTR value
  FE87  Pathname fully qualified flag (if $FF)
          Pathname: temp save area for index or..
  FE88  ONLINE: DEVCNT
  FE89  close-all error code
  FE8A  Set EOF: new Key Block pointer
  FE8C  New storage type (SET_EOF)
  FE8D  Freed Blocks count
  FE8F  EOF Block number (MSB then LSB)
  FE91  EOF byte offset into Block
  FE93  EOF - Master index counter
  FE94  Save area for index into table below

FE95 ********** DEVICE TABLE BUILT BY ONLINE **************************
          (also used by SET_EOF to keep track of
          8 blocks to be freed at a time)

  FE95  device table part one
  FE9D  device table part two

  FEA5  length of path, etc.
  FEA8  next buffer address
  FEAA  16 byte stack save area
  FEBA  6 byte zero page save area
  FECØ  Jump Vector, used for indirect jumps

FEC2 *********** $FEBF-$FEFF NOT USED *********************************
  FEC2  not used
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: D700
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

D700    MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  PRODOS MACHINE LANGUAGE INTERFACE   *
          *                                      *
          *    VERSION 1.3 -- 2 DEC 86           *
          *                                      *
          ****************************************

          THE 1.3 VERSION OF THE PRODOS 8 MLI IS THE SAME
          AS VERSION 1.2, INSTRUCTION FOR INSTRUCTION,
          FROM THE START ($DE00) TO ADDRESS $F992.  SOME
          BYTES BEFORE $F992 CHANGE BECAUSE THEY REFER TO
          ADDRESSES GREATER THAN $F992.

          ONLY THE PART OF THE MLI FROM $F980 TO $FEFF IS
          DOCUMENTED HERE FOR VERSION 1.3.  REFER TO THE
          1.2 VERSION FOR THE FIRST PART OF THE MLI.

F980    ---

          *** DESTROY NON-DIRECTORY FILE ***

  F980  save the storage type (FEB5)
  F987  set EOF to zero  (FEB5)
  F98D  byte offset = $200
  F992  turn on destroy flag  (FEEB)
  F995  "truncate" the file at EOF=0 <FA44>
  F998  turn off the destroy flag (FEEB)
  F99B  error during truncation >>F97E
  F9A3  free the key block in volume bitmap <EA1A>
  F9A6  error >>F97E
  F9A8  mark the file as deleted in DIR
  F9AD  decrement file count in DIR (FE47)
  F9B8  checkpoint volume bit map <EB76>
  F9BB  error >>F97E
  F9BD  update free block count in VCB <F9C3>
  F9C0  and go update the directory >>E4B2

          *** SUBROUTINE TO UPDATE FREE BLOCK ***
          *** COUNT IN VOLUME CONTROL BLOCK   ***

  F9C3  add blocks freed to total free blocks (FE85)
  F9C6  in VCB. (FEB6)
  F9D8  start next search for free blocks at
  F9DA  start of bitmap. (D91C)
  F9DD  exit
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: F9DD
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

          *** DESTROY DIRECTORY FILE ***

  F9DE  DIR file?
  F9E0  no, error >>FA2D
  F9E2  read volume bitmap block <EB43>
  F9E5  error? >>FA2C
  F9E7  BLKNUM = key block pointer (FE64)
  F9F1  read it <EBD9>
  F9F4  errors? >>FA2C
  F9F6  if DIR has any files... (DC25)
  FA00  access error
  FA05  write back block marking entry free (DC04)
  FA0B  error? >>FA2C
  FA0D  if "next_pointer" is zero.... (DC02)
  FA17  go back and pretend it's a seedling >>F99D
  FA19  else, (DC03)
  FA1C  free next block  <EA1A>
  FA1F  error? >>FA2C
  FA21  BLKNUM = next block (DC02)
  FA27  read it <EBC9>
  FA2A  if ok, continue in loop >>FA0D
  FA2C  else, error exit

  FA2D  incompatible file format error

FA32 ********* SET WRITE OCCURRED FLAG *******************************

  FA32  save some registers
  FA35  indicate write occurred (FE86)
  FA40  restore registers and exit
  FA43  RETURN

FA44 ********** TRUNCATE FILE AT EOF *********************************

  FA44  check storage type*16 (FEB5)
  FA47  seedling?
  FA49  yes >>FA58
  FA4B  no, sapling?
  FA4D  yes >>FA5B
  FA4F  no, tree?
  FA51  yes >>FA5E
  FA53  General error--wrong storage type
  FA55  jump to system death <BF0C>

  FA58  go to seedling truncate >>FB2F
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FA58
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

 FA5B  go to sapling truncate >>FAF6

 FA5E  truncate tree,
 FA60  at most 128 blocks in master index (FEBC)
 FA63  read the master index <FB5A>
 FA66  error? >>FAC8
 FA68  at EOF yet? (FEBC)
 FA6E  yes >>FAC9

         *** FREE WHOLE INDEX BLOCKS AFTER EOF ***
         (free 8 subindex blocks each time the
         master index block is read since we must
         share its buffer)

 FA70  copy up to 8 non-zero index block
 FA72  numbers to (DC00)
 FA75  a handy table (FEBE)
 FA86  ---
 FA8F  if there weren't 8 left to do, zero (FEBE)
 FA92  remainder of the table (FEC6)
 FA98  ---
 FA99  update master index counter (FEBC)
 FA9E  for all 8 entries: (FEBD)
 FAA1    set BLKNUM, (FEBE)
 FAA9    (exit when a 0 entry is found), >>FA63
 FAB0    read the sub-index block, <EBD9>
 FAB3    (quit if error), >>FAC8
 FAB5    zero all its blocks (if truncating) <FB95>
         or swap pages (if destroying),
 FAB8    (quit if error), >>FAC8
 FABA    write the former index block back out, <EBD5>
 FAC3    and loop until all 8 are done. >>FA9E
 FAC5  then go back and reread master index >>FA63
 FAC7  normal exit
 FAC8  RETURN

 FAC9  now go free all the sub-index blocks (FEB8)
 FACD  which follow EOF <FB97>
 FAD0  if error >>FAC8
 FAD2  write back master index <EBD5>
 FAD5  if error >>FAC8
 FAD7  EOF in first subindex? (FEB8)
 FADA  if so, demote to sapling file >>FAF1
 FADC  else, BLKNUM = subindex block which (DC00)
 FADF  contains the EOF mark
 FAE4  (exit if none there) >>FAC7
 FAEB  else, read the final subindex block <EBD9>
 FAEE  and treat it as a sapling file >>FAFB
 FAF0  unless there is an error.
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FAF0
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

 FAF1  Demote tree to sapling <FB63>
 FAF4  if error >>FAC8

         *** TRUNCATE SAPLING FILE ***

 FAF6  read index block <FB5A>
 FAF9  if error >>FAC8
 FAFB  index of last block in the file (FEB9)
 FAFE  add one to point past end of file
 FAFF  if zero, no blocks to free >>FB0B
 FB01  zero blocks past EOF (when truncating) <FB97>
       or swap bytes for all but first block (when destroying).
 FB04  if error >>FAC8
 FB06  write back modified index block <EBD5>
 FB09  if error >>FAC8
 FB0B  index of last block in file (FEB9)
 FB0E  this index block is empty! >>FB25
 FB10  Get BLKNUM of last data block (DC00)
 FB18  (no block allocated?) >>FAC7
 FB1F  read in last data block <EBD9>
 FB22  and treat it as a seedling file >>FB34
 FB24  unless error occurred.

 FB25  more index blocks (tree file)? (FEB8)
 FB28  yes, must be tree file >>FB10
 FB2A  no, demote to seedling <FB63>
 FB2D  if error >>FB59

         *** TRUNCATE SEEDLING FILE ***

 FB2F  read key block <FB5A>
 FB32  error? >>FB59
 FB34  EOF in first page? (FEBB)
 FB37  yes >>FB3F
 FB39  EOF in second page?
 FB3A  no, exactly 256 bytes >>FB58
 FB3C  get byte offset (FEBA)
 FB3F  ---
 FB41  zero bytes in second page  (DD00)
 FB47  EOF in first page? (FEBB)
 FB4A  no, we're done. >>FB55
 FB4C  yes, zero bytes in first page, too (FEBA)
 FB55  then write block back and exit >>EBD5

 FB58  exit normally
 FB59  RETURN
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FB59
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FB5A ********** READ INDEX BLOCK ************************************

  FB5A  Put index block number in A,X (FEB3)
  FB60  Go read the block >>EBC9

FB63 ********** DEMOTE FILE TO SMALLER FILE TYPE**********************

  FB63  get high byte of index block  (FEB4)
  FB66  save it on stack
  FB68  get low byte (FEB3)
  FB6B  save it, too
  FB6C  free the index block in the volume bitmap <EA1A>
  FB6F  restore the block number of the index block
  FB70  to zero page.
  FB75  if error writing bitmap >>FB94
  FB77  New index block is first block (DC00)
  FB7A  from old index block. (FEB3)
  FB83  For first entry in old index block,
  FB85  zero the block number (if truncating) <FBC7>
        or swap the bytes (if destroying).
  FB89  reduce storage type by one (FEB5)
  FB91  Write the deleted index block back out. <EBD5>
  FB94  RETURN

FB95 ******** FREE ALL BLOCK NUMBERS IN ******************************
           ***      AN INDEX BLOCK       ***

  FB95  ---

FB97 ******** FREE BLOCK NUMBERS BEYOND EOF **************************

  FB97  save BLKNUM
  FB9D  Save Y-register (index within block) (FE91)
  FBA8  if it is non-zero....
  FBAF  free the block in the volume bitmap <EA1A>
  FBB2  if error >>FBBE
  FBB4  Restore index to Y-reg (FE91)
  FBB7  zero this entry (when truncating) or <FBC7>
        swap the two bytes (when destroying).
  FBBA  ---
  FBBB  loop through all entries >>FB9D
  FBBE  save error message, if any
  FBC0  restore old BLKNUM
  FBC6  and exit
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FBC7
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FBC7 ********* ZERO OR SWAP INDEX BLOCK BYTES ***********************

  FBC7  --- >>0001
  FBC7  This a destroy operation? (FEEB)
  FBCA  Yes, swap the two bytes. >>FBCF
  FBCC   No, zero both bytes.
  FBCD  A 65C02 instruction!!! >>FBD5
         Note: we think this 65C02 instruction (BRA)
         snuck in by accident.  It is the only
         65C02 instruction in all of ProDOS and
         means the 1.3 version won't run on Apple IIs
         that don't have a 65C02.  But it is easy to
         patch this--just change the byte at $FBCD
         ($4CCD in the load image) from $80 to $F0,
         because BEQ works fine here.
  FBCF  Save higher page byte in X-register (DD00)
  FBD2  Get lower page byte in A-reg and (DC00)
  FBD5  store A-reg in higher page byte. (DD00)
  FBD8  Get X-register and
  FBD9  put it in lower page byte. (DC00)
  FBDC  RETURN

FBDD ********** ALLOCATE I/O BUFFER **********************************

  FBDD  ---
  FBDF  get I/O buffer page number
  FBE2  can't be below $800
  FBE4  else, error >>FC28
  FBE6  can't be above $BC00
  FBE8  else, error >>FC28
  FBED  $4A/$4B --> I/O buffer
  FBF1  must be page aligned! >>FC28
  FBF7  ---
  FBF8  check each page of I/O buffer for <FC63>
  FBFB  prior allocation in system bit map (BF58)
  FC08  ---
  FC09  if ok, mark each page as allocated <FC63>
  FC0C  in system memory bit map (BF58)
  FC19  assign buffer number (REFNUM*2) in FCB (D800)
  FC21  and save buffer location in buffer list
  FC26  exit
  FC27  RETURN

  FC28  bad I/O buffer error
  FC2B  RETURN
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FC2C
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FC2C ********** LOCATE I/O BUFFER ************************************

  FC2C  ---
  FC2D  AREG contains buffer number *2 (BF6E)
  FC3Ø  move buffer pointer to NXTBUF variable (FED1)
  FC39  exit

FC3A ********** FREE I/O BUFFER *************************************

  FC3A  is buffer already free? <FC2C>
  FC3F  yes, exit >>FC61
  FC43  zero its address in system global page (BF6F)
  FC5Ø  ---
  FC51  free each page in buffer <FC63>
  FC54  by marking system bit map
  FC61  exit
  FC62  RETURN

FC63 ********** LOCATE BIT MAP POSITION ******************************
         (GIVEN PAGE NUMBER)

  FC63  XREG contains page number
  FC64  compute page number times 8
  FC67  use as offset for bitmask (FDF4)
  FC6E  page number / 8 = byte offset
  FC6F  into bitmap
  FC71  exit

FC72 ********** CHECK BUFFER VALIDITY *********************************
                 START > $200    END < $BFØØ

  FC72  get buffer address (MSB)
  FC76  must be >$200 else error >>FC28
  FC78  get length (FECF)
  FC7E  compute last page no. of buffer
  FC83  ---
  FC8A  may not extend into $BFØØ
  FC8C  else, error >>FC28

        *** CHECK IF BLOCK OF MEMORY IS FREE ***

  FC8F  ---
  FC9Ø  see if this page is allocated <FC63>
  FC96  if so, error >>FC28
  FC98  else, check other paee also
  FC9C  then exit if both have been checked
  FC9D  RETURN
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FC9D
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FC9E ************************************************************************
          ****** MLI GET_BUFF CALL ******
          ********************************

  FC9E  get next available buffer
  FCA3  put its address in caller's parmlist
  FCAB  and exit
  FCAC  RETURN

FCAD ************************************************************************
          ****** MLI SET_BUFF CALL ******
          ********************************

  FCAD  mark his buffer allocated
  FCB2  error? >>FCD4
  FCB4  get old buffer address (FED2)
  FCBE  free old buffer's pages in map <FC49>
  FCC5  copy old buffer contents
  FCC7  to new buffer
  FCD3  then exit
  FCD4  RETURN

FCD5 ********* GO TO QUIT CODE HANDLER *******************************

  FCD5  enable 2nd 4K bank of language card (CØ83)
  FCD8  (Quit code lives at $D1ØØ-$D3FF) (CØ83)
  FCDD  Get first four bytes of page Ø, (ØØØØ)
  FCEØ  save them on the stack
  FCE4  Set ($ØØ) -> $D1ØØ
  FCE6  Set ($Ø2) -> $1ØØØ
  FCF2  Set Y = Ø
  FCF3  3 pages of code to copy
  FCF5  ---
  FCF6  copy quit code handler to $1ØØØ
  FDØ4  pull 4 saved bytes off stack
  FDØD  enable HIGH RAM BANK1 (CØ8B)
  FD1Ø  (MLI) (CØ8B)
  FD15  point RESET vector at $1ØØØ (Ø3F2)
  FD1D  set power-up byte properly
  FD22  go to quit code handler at $1ØØØ >>1ØØØ

FD25 ********* ACCESS RAM-BASED DEVICE DRIVER ************************
            This (undocumented?) routine allows a device driver
            to reside in BANK2 of auxiliary high RAM (they normally
            reside in slot ROM).  When the device driver is set up,
            the address of this routine, which may be found at $3EA,
            becomes the address of the device driver.  Bytes $3E4 and $3E5
            are changed to the address of the real driver in aux high RAM.
            This routine must call the page 3 routine at $3D6
            because the MLI is in main high RAM and will be
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FD25
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

          swapped out.  The page 3 routine calls the real driver
          and returns here with the error code, if any.

  FD25  Get current P-reg in accumulator,
  FD27  then save it on the stack
  FD28  clear overflow flag
  FD29  interrupts disabled?
  FD2B  no >>FD30
  FD2D  yes, set overflow flag (FD4E)
  FD30  disable interrupts
  FD31  enable RAM, BANK2 (C083)
  FD37  set carry, indicating error
  FD38  indicate 6 bytes to move to aux z-page
  FD3A  Call real driver thru page 3 routine <03D6>
  FD3D  store error number (BF0F)
  FD40  enable RAM, BANK1 (C08B)
  FD46  restore original P-reg
  FD48  if error number is zero, (BF0F)
  FD4B  then indicate no error; >>FD4E
  FD4D  otherwise indicate error
  FD4E  RETURN

FD4F ********** INSTALL UNCLAIMED IRQ HANDLER ************************
          This routine calls a subroutine located
          at $D400 in BANK2 of high RAM.  It is called
          when MLI command $42 is executed.  Its purpose
          is to install a routine that handles unclaimed
          interrupts.  Apparently the user must supply
          the routine at $D400.

  FD4F  Switch to BANK2 of high RAM, (C083)
  FD52  execute the program there, <D400>
  FD55  then back to BANK1 (C08B)
  FD58   and return.

FD59 ************************************************************
          *       DATA AREA                  *
          ************************************

FD59 ********** MLI COMMAND TABLE ************************************
          IN HASH CODE ORDER: IF COMMAND IS...
          ABCD EFGH (IN BINARY BITS)
          INDEX IS COMPUTED AS:
             000D EFGH
            +0000 ABCD

  FD59  GET BUF
  FD5A  UNUSED
  FD5B  UNUSED
  FD5C  UNUSED
  FD5D  ALLOC INTERRUPT
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FD5E
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FD5E  DEALLOC INTERRUPT
  FD60  UNUSED
  FD61  READ BLOCK
  FD62  WRITE BLOCK
  FD63  GET TIME
  FD64  EXIT
  FD65  CREATE
  FD66  DESTROY
  FD67  RENAME
  FD68  SET FILE INFO
  FD69  GET FILE INFO
  FD6A  ON LINE
  FD6B  SET PREFIX
  FD6C  GET PREFIX
  FD6D  OPEN
  FD6E  NEWLINE
  FD6F  READ
  FD70  WRITE
  FD71  CLOSE
  FD72  FLUSH
  FD73  SET MARK
  FD74  GET MARK
  FD75  UNUSED
  FD76  SET EOF
  FD77  GET EOF
  FD78  SET BUF

FD79 ********** PARAMETER COUNT TABLE *********************************

  FD79  GET BUF
  FD7A  UNUSED
  FD7B  UNUSED
  FD7C  UNUSED
  FD7D  ALLOC INTERRUPT
  FD7E  DEALLOC INTERRUPT
  FD80  UNUSED
  FD81  READ BLOCK
  FD82  WRITE BLOCK
  FD83  GET TIME
  FD84  EXIT
  FD85  CREATE
  FD86  DESTROY
  FD87  RENAME
  FD88  SET FILE INFO
  FD89  GET FILE INFO
  FD8A  ON LINE
  FD8B  SET PREFIX
  FD8C  GET PREFIX
  FD8D  OPEN
  FD8E  NEWLINE
  FD8F  READ
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FD90
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FD90  WRITE
  FD91  CLOSE
  FD92  FLUSH
  FD93  SET MARK
  FD94  GET MARK
  FD95  UNUSED
  FD96  SET EOF
  FD97  GET EOF
  FD98  SET BUF

FD99 ********** MLI COMMAND ADDRESS TABLE ****************************

  FD99  CREATE
  FD9B  DESTROY
  FD9D  RENAME
  FD9F  SET FILE INFO
  FDA1  GET FILE INFO
  FDA3  ON LINE
  FDA5  SET PREFIX
  FDA7  GET PREFIX
  FDA9  OPEN
  FDAB  NEWLINE
  FDAD  READ
  FDAF  WRITE
  FDB1  CLOSE
  FDB3  FLUSH
  FDB5  SET MARK
  FDB7  GET MARK
  FDB9  SET EOF
  FDBB  GET EOF
  FDBD  SET BUF
  FDBF  GET BUF

FDC1 ********** MLI COMMAND INFO BYTE *********************************

          PATHNAME FLAG
          | REFERENCE NUMBER FLAG
          | | DATETIME STAMP FLAG
          | | |     COMMAND NUMBER
          | | |     |
  FDC1    1 0 1  - 00
  FDC2    1 0 1  - 01
  FDC3    1 0 1  - 02
  FDC4    1 0 1  - 03
  FDC5    1 0 0  - 04
  FDC6    0 0 0  - 05
  FDC7    0 0 0  - 06
  FDC8    0 0 0  - 07
  FDC9    1 0 0  - 08
  FDCA    0 1 0  - 09
  FDCB    0 1 0  - 0A
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FDCC
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FDCC    0 1 0  - 0B
  FDCD    0 0 1  - 0C
  FDCE    0 0 1  - 0D
  FDCF    0 1 0  - 0E
  FDD0    0 1 0  - 0F
  FDD1    0 1 0  - 10
  FDD2    0 1 0  - 11
  FDD3    0 1 0  - 12
  FDD4    0 1 0  - 13

FDD5 ********** CONSTANTS - DATA AREA ********************************

  FDD5  Blocks Used
  FDD7  End of File
  FDDA  Special ID (Must be 5 bits on)
  FDDB  'HUSTON!'       Author's name
  FDE2  Previous Block of Vol Dir Key Block
          ---
        THE FOLLOWING IS COPIED TO SUBDIR HDR+$20
  FDE4  Version of ProDOS
  FDE5  Minimum Version
  FDE6  Access Byte  (D|Rn|B|000|W|R)
  FDE7  Entry Length
  FDE8  Entries per Block
  FDE9  File Count
  FDEB  Parent LSB (copied to SUBDIR HDR +$20)
          ---
  FDEC  File Type  (Directory)
  FDED  Block Number
  FDEF  Number of Blocks
  FDF1  End of File

FDF4 ********** BITMASK TABLE ***************************************

  FDF4  10000000
  FDF5  01000000
  FDF6  00100000
  FDF7  00010000
  FDF8  00001000
  FDF9  00000100
  FDFA  00000010
  FDFB  00000001

FDFC ********** OFFSETS INTO FILE CONTROL BLOCKS *********************
FDFC ***(FCB's are at $D800-$D8FF)**********************************

  FDFC  Key Block
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FDFD
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

          .

  FDFE  # Blocks Used

  FE00  End of File

FE03 ********** SET/GET FILE_INFO OFFSETS ****************************

  FE03  Access
  FE04  File Type
  FE05  Aux Type
  FE07  Storage Type
  FE08  Blocks Used (MSB on means GET only no SET

  FE0A  Datetime (Last Mod)

  FE0E  Datetime (Creation)

FE12 ********** FATAL ERROR MESSAGE **********************************

  FE12  ' INSERT SYSTEM DISK AND RESTART  -ERR 0 '

  FE3A  ---

FE3A ********** VARIABLES - DATA AREA ********************************

  FE3A  Parent Pointer Block
  FE3C  Parent Entry Number
  FE3D  Parent Entry Length
  FE3E  Datetime (Creation)
  FE42  Version
  FE43  Min Version
  FE44  Access Byte
  FE45  Entry Length
  FE46  Entries per Block
  FE47  File Count
  FE49  Bit Map Pointer
  FE4B  Total Blocks
          THE FOLLOWING 6 BYTES UNIQUELY IDENTIFY
          A FILE:
  FE4D  Device Number
  FE4E  Current Directory Block Number (HDR)
  FE50  Block Number of File Entry in Directory
  FE52  File Entry Number in Directory

FE53 ********** FILE ENTRY BUFFER ************************************

  FE53  Type/Length  (TTTTLLLL)
  FE54  File Name (Max 15) >>000F
  FE63  File Type
  FE64  Key Pointer
  FE66  Blocks Used
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                    NEXT OBJECT ADDR: FE68
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FE68  End of File
  FE6B  Datetime (Creation)
  FE6F  Version
  FE70  Min Version
  FE71  Access Attribute
  FE72  Aux Type (Load Address/Record Length)
  FE74  Datetime (Last Mod)

  FE78  Header Pointer

FE7A ********** Variable Work Area ************************************

  FE7A  3 Byte Scratch

  FE7D  ---

  FE7E  End of File

  FE81  Previous Mark

  FE84  Compare Vol Name Scratch
  FE85  Offset into VCB Table ($D900)
  FE86  Offset into FCB Table ($D800)
  FE87  Free FCB found Flag

  FE88  Number of Free Blocks needed

  FE8A  Storage Type
          Number of Entries Examined or..
  FE8B  FCB already open flag
  FE8C  File Count

  FE8E  Entries/Block Loop Count/Free FCB's refnum
          Free Entry Found Flag (if > 0) or..
          # of 1st bitmap block with free bit on or..
  FE8F  bit for free
  FE90  # Blocks in Bitmap left to search
  FE91  Y Register temp
  FE92  Pathname Length
  FE93  Devnum for Prefix Directory Header
  FE94  Block of Prefix Directory Header
  FE96  Bitmap Byte Offset in Page
  FE97  Bitmap Page Offset
  FE98  Bitmap Buffer Page (0 or 1)
  FE99  Bitmap Flag (if $80, needs writing)
  FE9A  Bitmap DEVNUM
  FE9B  Bitmap Block Number
  FE9D  Bitmap Block offset for Multiblock Bitmaps
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                NEXT OBJECT ADDR: FE9D
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

          New Mark to be Positioned to for Set Mark
          or New Moving Mark (for READ)
  FE9E  or New EOF for SET_EOF

  FEA1  Request Count (Read/Write etc.)
  FEA3  Multi-Block I/O count
  FEA4  Newline character
  FEA5  Newline mask
  FEA6  I/O Transfer occurred flag
  FEA7  MLI Command * 2
  FEA8  ORed into Access Flags ($20 - Backup)
  FEA9  Duplicate Volume Flag (if $FF)
  FEAA  Duplicate Volume's VCB index
  FEAB  MLI function code (low 5 bits)
          Characters in current Pathname indx lvl or
  FEAC  ONLINE: volname len - loop index
  FEAD  new pathname: index to last name
          old pathname: index to last name or..
  FEAE  ONLINE: index to data buffer
  FEAF  Old PFIXPTR value
  FEB0  Pathname fully qualified flag (if $FF)
          Pathname: temp save area for index or..
  FEB1  ONLINE: DEVCNT
  FEB2  close-all error code
  FEB3  Set EOF: new Key Block pointer
  FEB5  New storage type (SET_EOF)
  FEB6  Freed Blocks count
  FEB8  EOF Block number (MSB then LSB)
  FEBA  EOF byte offset into Block
  FEBC  EOF - Master index counter
  FEBD  Save area for index into table below

FEBE ********** DEVICE TABLE BUILT BY ONLINE ************************
          (also used by SET_EOF to keep track of
          8 blocks to be freed at a time)

  FEBE  device table part one
  FEC6  device table part two

  FECE  length of path, etc.
  FED1  next buffer address
  FED3  16 byte stack save area
  FEE3  6 byte zero page save area

  FEE9  ---
  FEE9  Jump Vector, used for indirect jumps
  FEEB  Destroy flag (1 = destroy operation)
```

```
ProDOS MLI -- V1.3 -- 2 DEC 86                NEXT OBJECT ADDR: FEEB
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

FEEC ********** $FEEC-$FEFF NOT USED *******************************
  FEEC  not used
```

```
ProDOS System Global Page -- V1.2                NEXT OBJECT ADDR: BF00
--------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

BF00    MODULE STARTING ADDRESS

          ***********************************
          *                                 *
          * PRODOS SYSTEM GLOBAL PAGE       *
          *                                 *
          *    VERSION 1.2 -- 6 SEP 86      *
          *    VERSION 1.3 -- 2 DEC 86      *
          *                                 *
          ***********************************

BF00 ******** ML1 AND IRQ HANDLER EQUATES ****************************

DE00    Main MLI entry point.
DEAC    Address for no device connected.
DF4E    IRQ handler within MLI.
DFFF    System error handler.
E009    System death handler.
FFD8    Patch in ProDOS IRQ Handler.

BF00 *********** JUMP VECTORS ***************************************

  BF00  ENTRY       JMP to ML1. >>BF4B
  BF03  JSPARE      System death address. >>BF03
  BF06  DATETIME    JMP To Date/Time routine (RTS if no clock).
  BF07              Normal clock code address.
  BF09  SYSERR      JMP to system error handler. >>DFFF
  BF0C  SYSDEATH    JMP to system death handler. >>E009
  BF0F  SERR        System error number.

BF10 ********** DEVICE INFORMATION **********************************

  BF10  DEVADR01    Slot 0 reserved.
  BF12  DEVADR11    Slot 1, drive 1 device driver address.
  BF14  DEVADR21    Slot 2, drive 1 device driver address.
  BF16  DEVADR31    Slot 3, drive 1 device driver address.
  BF18  DEVADR41    Slot 4, drive 1 device driver address.
  BF1A  DEVADR51    Slot 5, drive 1 device driver address
  BF1C  DEVADR61    Slot 6, drive 1 device driver address.
  BF1E  DEVADR71    Slot 7, drive 1 device driver address.
  BF20  DEVADR02    Slot 0 reserved.
  BF22  DEVADR12    Slot 1, drive 2 device driver address.
  BF24  DEVADR22    Slot 2, drive 2 device driver address.
  BF26  DEVADR32    /RAM device address (128K required).
  BF28  DEVADR42    Slot 4, drive 2 device driver address.
  BF2A  DEVADR52    Slot 5, drive 2 device driver address
  BF2C  DEVADR62    Slot 6, drive 2 device driver address.
  BF2E  DEVADR72    Slot 7, drive 2 device driver address.
```

```
ProDOS System Global Page -- V1.2                NEXT OBJECT ADDR: BF2E
--------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

  BF30  DEVNUM      Slot and drive (DSSS0000) of last device.
  BF31  DEVCNT      Count (minus 1) of active devices
  BF32  DEVLST      List of active devices (slot, drive, and
                    identification--DSSSIIII).

  BF40  "(C)APPLE'83"           Copyright notice.

BF4B ******** PATCHES TO ORIGINAL GLOBAL PAGE ************************

  BF4B  ML1ENT1     Push status reg on stack.
  BF4C              Disable interrupts
  BF4D              Go to MLIENT1. >>BFB7

  BF50  AFT1RQ      Read high RAM, BANK1 (C08B)
  BF53              and continue IRQ exit. >>FFD8

  BF58  BITMAP      Bitmap of low 48K of memory.

  BF70  BUFFER1     Open file 1 buffer address.
  BF72  BUFFER2     Open file 2 buffer address.
  BF74  BUFFER3     Open file 3 buffer address.
  BF76  BUFFER4     Open file 4 buffer address.
  BF78  BUFFER5     Open file 5 buffer address.
  BF7A  BUFFER6     Open file 6 buffer address.
  BF7C  BUFFER7     Open file 7 buffer address.
  BF7E  BUFFER8     Open file 8 buffer address.

BF80 *********** INTERRUPT INFORMATION ******************************

  BF80  INTRUPT1    Interrupt handler address (highest priority).
  BF82  INTRUPT2    Interrupt handler address.
  BF84  INTRUPT3    Interrupt handler address.
  BF86  INTRUPT4    Interrupt handler address (lowest priority).
  BF88  INTAREG     A-register savearea.
  BF89  INTXREG     X-register savearea.
  BF8A  INTYREG     Y-register savearea.
  BF8B  INTSREG     S-register savearea.
  BF8C  INTPREG     P-register savearea.
  BF8D  INTBANKID   Bank ID byte (ROM, RAM1, or RAM2).
  BF8E  INTADDR     Interrupt return address.

BF90 *********** GENERAL SYSTEM INFO *********************************

  BF90  DATE        YYYYYYYM MMMDDDDD.
  BF92  TIME        ...HHHHH ..MMMMMM.
  BF94  LEVEL       Current file level.
  BF95  BUBIT       Backup bit.
  BF96  SPARE1      Currently unused.
  BF98  MACHID      Machine ID byte.
                    00.. 0...  II
```

```
ProDOS System Global Page -- V1.2                    NEXT OBJECT ADDR: BF99
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

                    01.. 0...  II+
                    10.. 0...  IIe or IIGS
                    11.. 0...  Future expansion
                    00.. 1...  Future expansion
                    01.. 1...  Future expansion
                    10.. 1...  IIc
                    11.. 1...  Future expansion
                    ..00 ....  Unused
                    ..01 ....  48K
                    ..10 ....  64K
                    ..11 ....  128K
                    .... .X..  Reserved
                    .... ..0.  No 80-column display
                    .... ..1.  80-column display
                    .... ...0  No compatible clock
                    .... ...1  Compatible clock present

  BF99  SLTBYT      Slot ROM map (bit on indicates ROM present)
  BF9A  PFIXPTR     Prefix flag (0 indicates no active prefix).
  BF9B  MLIACTV     MLI active flag (1... .... indicates active.
  BF9C  CMDADR      Last MLI call return address.
  BF9E  SAVEX       X-register savearea for MLI calls.
  BF9F  SAVEY       Y-register savearea for MLI calls.

BFA0 ******** HANDLE BANK SWITCHING AFTER IRQ ***** ******************
       (Enter reading high RAM, BANK1)

  BFA0  EXIT        $E000 same as save byte? (E000)
  BFA3              Yes, check for BANK1/BANK2 >>BFAA
  BFA5              No, enable ROM (C082)
  BFA8              and exit now. >>BFB5
  BFAA  EXIT1       Get RAM save byte for $D000. (BFF5)
  BFAD              Is it the same as BANK1? (D000)
  BFB0              Yes, exit now. >>BFB5
  BFB2              No, switch to BANK2. (C083)
  BFB5  EXIT2       Restore A-Register and
  BFB6              return from the interrupt.

BFB7 ******** MLI ENTRY, CONTINUED **********************************

  BFB7  MLICONT     Carry set will
  BFB8              roll flag bit into MLIACTV. (BF9B)
  BFBB              Save high memory configuration (E000)
  BFBE              by storing $E000 in BNKBYT1 (BFF4)
  BFC1              and $D000 (D000)
  BFC4              in BNKBYT2. (BFF5)
  BFC7              Then enable high RAM, BANK1 (C08B)
  BFCA              for read and write. (C08B)
  BFCD              Jump to actual MLI. >>DE00
```

```
ProDOS System Global Page -- V1.2                    NEXT OBJECT ADDR: BFCD
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

BFD0 *********** INTERRUPT ROUTINES **********************************

  BFD0  IRQXIT      Determine state of high memory. (BF8D)
  BFD3              High RAM, BANK1 enabled. >>BFE2
  BFD5              High RAM, BANK2 enabled. >>BFDF
  BFD7              System have only 48K?
  BFD8              Yes, only ROM in high memory. >>BFE7
  BFDA              Enable ROM. (C081)
  BFDD              Always branch. >>BFE7
  BFDF  IRQXIT1     Switch to BANK2. (C083)
  BFE2  IRQXIT2     Preset BANKID for ROM.
  BFE4              (Later reset if high RAM interrupt). (BF8D)
  BFE7  ROMXIT      Restore accumulator and  (BF88)
  BFEA              exit.

  BFEB  IRQENT      Enable high RAM, BANK1 (C08B)
  BFEE              for read and write. (C08B)
  BFF1              Jump into MLI. >>DF4E

BFF4 *********** DATA ************************************************

  BFF4  BNKBYT1     Storage for byte at $E000.
  BFF5  BNKBYT2     Storage for byte at $D000.
  BFF6              $BFF6-$BFFB currently not used.

BFFC *********** VERSION INFORMATION *********************************

  BFFC  IBAKVER     Minimum version of Kernel needed for this interpreter.
  BFFD  IVERSION    Version number of this in interpreter.
  BFFE  KBAKVER     Currently undefined. Reserved for future use.
  BFFF  KVERSION    MLI Version number:
                     =2 in Version 1.2
                     =3 in Version 1.3
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: 1000
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

1000    MODULE STARTING ADDRESS

            ************************************
            *                                  *
            * QUIT Code                        *
            *     Stored in BANK2 of High RAM  *
            *     at $D100.  A move routine in *
            *     the MLI moves the code to    *
            *     $1000 and JMPs to it when a  *
            *     QUIT command is issued.      *
            *                                  *
            * VERSION 1.2 -- 6 SEP 86          *
            *   Move routine at $FCA9          *
            *                                  *
            * VERSION 1.3 -- 2 DEC 86          *
            *   Move routine at $FCD5          *
            *                                  *
            ************************************

1000 ********** ZERO PAGE EQUATES ***********************************

0024    Cursor Horizontal
0025    Cursor Vertical

1000 ********** EXTERNAL EQUATES *************************************

0280    Prefix Buffer
1800    Buffer
2000    Buffer
BF00    MLI Entry
BF58    Bitmap

1000 ********** SOFT SWITCHES ****************************************

C000    Keyboard
C000    Disable 80 column store
C00C    Disable 80 column card
C00E    Select standard character set
C082    ROM select

1000 ********** MONITOR EQUATES **************************************

FE84    Initialize 40-column display
FC58    Home
FC9C    Clear to end of line
FD0C    Read a key
FD8E    Output a Carriage Return
FDED    Output a Character
FE84    Set Normal display
FE89    Set Keyboard
FE93    Set Video
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: 1000
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FF3A    Sound Bell

1000 ********** INITIALIZATION ****************************************

  1000  Select ROM (C082)
  1003  Disable 80 column card (C00C)
  1006  Select standard character set    (C00E)
  1009  Clear 80-column store    (C000)
  100C  Set Normal display (white on black) <FE84>
  100F  Initialize 40-column display <FE84>
  1012  Set Video <FE93>
  1015  Set Keyboard <FE89>

1018 ********** INITIALIZE MEMORY BITMAP *****************************

  1018  Mark pages $0, $1, $4 through $7
  101A  and $BF as in use

102D ********** DISPLAY CURRENT PREFIX *******************************

  102D  Clear Screen and Home cursor <FC58>
  1030  Go down 1 line <FD8E>
  1033  Point to prompt number 1
  1035  and print it out   <11D6>
  1038  Position to line 3
  103F  Call MLI (GET_PREFIX) <BF00>
  1042  Data: GET_PREFIX command number
  1043  Data: Pointer to Parameter list
  1045  Get length of Prefix (0280)
  1048  Put a 0
  104A  at the end of the Prefix (0281)
  104D  Check prefix length... (0280)
  1050  If length=0, there is no current Prefix >>105D
  1052  If non-zero, display the current Prefix (0280)
  1057  on the video screen (05FF)

105D ********** GET PREFIX NAME ***************************************

  105D  Initialize counter
  1064  Read a key <FD0C>
  1067  Is it CARRIAGE RETURN?
  1069  Yes, then accept Prefix >>10BD
  106B  No, then save character
  106C  Clear to end of line <FC9C>
  106F  Retrieve character
  1070  Is it ESCAPE?
  1072  Yes, start all over again >>102D
  1074  Is it CANCEL?
  1076  Yes, start all over again >>102D
  1078  Is it TAB?
  107A  Yes, sound Bell, get another character >>1093
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: 107C
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  107C  Is it DELETE?
  107E  Yes. >>1084
  1080  Is it BACKSPACE?
  1082  No, keep checking >>1091
  1084  Yes, is there room to move back?
  1086  No, don't try >>108B
  1088  Decrement cursor horizontal position
  108A  Decrement counter
  108B  Clear to end of line <FC9C>
  108E  Try again >>1064

  1091  Continue if greater or equal to BACKSPACE >>1099
  1093  Else, sound Bell <FF3A>
  1096  Try again >>1064

  1099  Is it less than or equal to "Z"?
  109B  Yes, keep checking >>109F
  109D  Turn off lowercase
  109F  Is it less than "."?
  10A1  Yes, Invalid - try again >>1093
  10A3  Is it greater than "Z"?
  10A5  Yes, Invalid - try again >>1093
  10A7  Is it less than or equal to "9"?
  10A9  Yes, keep checking >>10AF
  10AB  Is it less than "A"?
  10AD  Yes, Invalid - try again >>1093
  10AF  Else, valid character - increment counter
  10B0  Found 39 characters?
  10B2  Yes, then start all over >>1076
  10B4  Put valid character in buffer (0280)
  10B7  and Print it <FDED>
  10BA  Go back for more >>1064

  10BD  Check counter
  10BF  If 0 then go on >>10D3
  10C1  Else, save length (0280)
  10C4  Call MLI (SET_PREFIX) <BF00>
  10C7  Data: SET_PREFIX command number
  10C8  Data: Pointer to Parameter list
  10CA  Carry on if no error >>10D3
  10CC  Sound Bell <FF3A>
  10CF  Force branch to
  10D1  always be taken >>1076

10D3 ********** GET APPLICATION NAME **********************************

  10D3  Clear Screen and Home cursor <FC58>
  10D6  Go down 1 line <FD8E>
  10D9  Point to prompt number 2
  10DB  and print it out <11D6>
  10DE  Position to line 3
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: 10E5
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  10E5  Initialize counter
  10E7  Wait for keypress <FD0C>
  10EA  Is it ESCAPE?
  10EC  No, keep checking  >>10F4
  10EE  Yes, get Cursor horizontal position
  10F0  If not 0 try again >>10D3
  10F2  If 0 start all over again >>10D1
  10F4  Is it CANCEL?
  10F6  Yes, try again >>10D3
  10F8  Is it TAB?
  10FA  Yes, sound Bell - try again >>1109
  10FC  Is it DELETE?
  10FE  Yes >>1104
  1100  Is it BACKSPACE?
  1102  No, keep checking >>1107
  1104  Yes, then handle it >>11C0

  1107  Continue if greater than BACKSPACE >>110F
  1109  Sound Bell <FF3A>
  110C  Go back and try again >>10E7

  110F  Is it CARRIAGE RETURN?
  1111  Yes, then go load Application >>113C
  1113  Is it less than or equal to "Z"?
  1115  Yes, keep checking >>1119
  1117  Turn off lower case
  1119  Is it less than "."?
  111B  Yes, Invalid - try again >>1109
  111D  Is it greater than "Z"?
  111F  Yes, Invalid - try again >>1109
  1121  Is it less than or equal to "9"?
  1123  Yes, keep checking >>1129
  1125  Is it less than "A"?
  1127  Yes, Invalid - try again >>1109
  1129  Else, valid character - save it
  112A  Clear to end of line <FC9C>
  112D  Retrieve character
  112E  and Print it <FDED>
  1131  Increment counter
  1132  Found 39 characters?
  1134  Yes, start again >>10F6
  1136  No, save character in buffer (0280)
  1139  and go get another >>10E7

113C ********** LOAD AND EXECUTE APPLICATION ************************

  113C  Output a blank
  1141  Store length of Application name (0280)
  1144  Call MLI (GET_FILE_INFO) <BF00>
  1147  Data: GET_FILE_INFO command number
  1148  Data: Pointer to Parameter list
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 114A
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  114A  Continue if no error >>114F
  114C  Else, go to Error Handler >>11E2

  114F  Get File Type (12A5)
  1152  Is it ProDOS System file?
  1154  Yes, continue >>115B
  1156  No, indicate Error $01
  1158  Go to Error Handler >>11E2

  115B  Set Reference number to 0
  1160  Call MLI (CLOSE) <BF00>
  1163  Data: CLOSE command number
  1164  Data: Pointer to Parameter list
  1166  Continue if no error >>116B
  1168  Else, go to Error Handler >>11E2
  116B  Get Access Byte (12A4)
  1170  Yes, >>1177
  1172  No, Indicate Error $27
  1174  Go to Error Handler >>11E2

  1177  Call MLI (OPEN) <BF00>
  117A  Data: OPEN command number
  117B  Data: Pointer to Parameter list
  117D  Continue if no error >>1182
  117F  Else, go to Error Handler >>11E2

  1182  Get Reference Number (12B8)
  1185  and update READ and (12BC)
  1188  GET_EOF parameter lists (12C4)
  118B  Call MLI (GET_EOF) <BF00>
  118E  Data: GET_EOF command number
  118F  Data: Pointer to Parameter list
  1191  If error, handle it >>11E2

  1193  Is EOF mark less than $10000 (12C7)
  1196  Yes, continue on >>119C
  1198  No, Indicate Error $27
  119A  Go to Error Handler >>11E2

  119C  Transfer EOF to Request count (12C5)
  119F  in READ parameter list (12BF)
  11A8  Call MLI (READ) <BF00>
  11AB  Data: READ command number
  11AC  Data: Pointer to Parameter list
  11AE  Save status of READ
  11AF  Call MLI (CLOSE) <BF00>
  11B2  Data: Get_Prefix command number
  11B3  Data: Pointer to Parameter list
  11B5  Continue if no error >>11BB
  11B7  Else, retrieve status
  11B8  and go to Error Handler >>11E2
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: 11BA
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

        This area of the code was modified for
        Version 1.2, and a bug was created.
        We are not sure it is safe to assume that
        the P-register is non-zero; that is, a BNE
        may not force the required branch.
        Also, there is a misplaced label here that
        will cause read errors to be ignored.

  11BA  Was READ good?
  11BB  No, go to Error Handler >>11B7
  11BD  Yes, execute application >>2000

11C0 ********** BACKSPACE ROUTINE ************************************

  11C0  Get cursor position horizontal
  11C2  If 0 exit routine >>11D3
  11C4  Decrement counter
  11C5  Output a space
  11CA  Move cursor back 2 spaces
  11CE  Output a space <FDED>
  11D1  Move cursor back 1 space
  11D3  Return to get another character >>10E7

11D6 ********** PRINT TEXT ROUTINE ***********************************

  11D6  Get a character (1211)
  11D9  If it is 0 then exit >>11E1
  11DB  Output it <FDED>
  11DE  Increment offset
  11DF  Get another character >>11D6
  11E1  Return to caller

11E2 ********** PRINT ERROR MESSAGE **********************************

  11E2  Save Accumulator (Error Number)
  11E4  Position to line 12
  11EB  Get Error number
  11ED  Is it 1?
  11EF  No, keep checking >>11F5
  11F1  Yes, point to error message 1
  11F3  and go print it >>120B
  11F5  Is it $40?
  11F7  Yes, print error message 3 >>1209
  11F9  Is it $44?
  11FB  Yes, print error message 3  >>1209
  11FD  Is it $45?
  11FF  Yes, print error message 3 >>1209
  1201  Is it $46?
  1203  Yes, print error message 3 >>1209
  1205  Point to error message 2
  1207  and go print it >>120B
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: 1209
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  1209  Point to error message 3
  120B  Print Error message <11D6>
  120E  Get application name again >>10DE

1211 ********** ASCII TEXT ****************************************

        Prompt1
  1211  'ENTER PREFIX (PRESS "RETURN" TO ACCEPT)'

        Prompt2
  1239  'ENTER PATHNAME OF NEXT APPLICATION'

        Error1
  125C  Ring Bell
  125D  'NOT A TYPE "SYS" FILE'

        Error2
  1273  Ring Bell
  1274  'I/O ERROR            '

        Error3
  128A  Ring Bell
  128B  'FILE/PATH NOT FOUND   '

12A1 ********** PARAMETER LISTS ************************************

        GET_FILE_INFO Parmlist
  12A1  Parmcount
  12A2  Pathname
  12A4  Access
  12A5  File Type
  12A6  Aux Type
  12A8  Storage Type
  12A9  Blocks Used
  12AB  Datetime (modified)
  12AF  Datetime (creation)

        OPEN Parmlist

  12B3  Parmcount
  12B4  Pathname
  12B6  I/O Buffer
  12B8  Reference Number

        CLOSE Parmlist

  12B9  Parmcount
  12BA  Reference Number
```

```
ProDOS QUIT Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: 12BA
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

        READ Parmlist

  12BB  Parmcount
  12BC  Reference Number
  12BD  Data Buffer
  12BF  Request Count
  12C1  Transfer Count

        GET_EOF Parmlist

  12C3  Parmcount
  12C4  Reference Number
  12C5  EOF Mark

        GET/SET_PREFIX Parmlist

  12C8  Parmcount
  12C9  Pathname

12CB *********** $12CB-$12FF UNUSED *********************************

  12CB  These unused bytes are $D3CB-$D3FF in high RAM
  12FF  and $5BCB-$5BFF when loaded as part of "PRODOS" file.
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D000
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

D000    MODULE STARTING ADDRESS

         ************************************
         *                                  *
         *  5.25" DISK DEVICE DRIVER        *
         *                                  *
         *      RESIDES AT $D000-$D6FF      *
         *                                  *
         *  VERSION 1.2 -- 6 SEP 86         *
         *   (SAME AS IN VERSION 1.1.1)     *
         *                                  *
         ************************************

D000 ********** ZERO PAGE EQUATES ***********************************

003A    Checksum
003A    Workbyte
003E    Slot (Temporary)
0042    Command
0043    Unit Number
0044    I/O Buffer Pointer (low)
0045    I/O Buffer Pointer (high)
0046    Block Number (low)
0047    Block Number (high)

D000 ********** INTERNAL EQUATES *************************************

1000    Dummy Block Buffer (1st half)
1100    Dummy Block Buffer (2nd half)

D000 ********** EXTERNAL EQUATES *************************************

C080    Phase Zero Off
C088    Motor Off
C089    Motor On
C08A    Drive Select
C08C    Read Data Register
C08D    Write Data Register
C08E    Set Read Mode
C08F    Set Write Mode
C0EC    Read Data Register (slot 6)

D000 ********** 5.25" DISK DRIVER ENTRY ******************************

  D000  Clear decimal mode
  D001  Clear phases in case IWM device in this slot <D6BE>
  D004  Five NOP's so code below will
  D005  fit up against Table at $D196
  D009  Check validity of calling parameters  <D6D0>
  D00C  If not valid exit with error >>D034
  D00E  Convert Block Number to a Track and Sector
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D010
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  D010  ---
  D014  00000000T TTTTTABC
  D015            .     . >>D010
  D017          .   .
  D018        .       . >>D01C
  D01A  00TTTTTT 0000BC0A
  D01C  ---
  D020  Preserve Sector Number
  D021  Execute command <D038>
  D024  Restore Sector Number - Was prior action ok?
  D025  No, then exit >>D030
  D027  Increment Buffer Pointer
  D029  Increment Sector Number by 2 for rest of Block
  D02B  Execute command <D038>
  D02E  Decrement Buffer Pointer (to start of block)
  D030  Get error number (if any - 0 indicates no error) (D358)
  D033  Return to caller

D034 ********** I/O ERROR ROUTINE ************************************

  D034  Indicate "I/O Error"
  D036  Set Carry flag
  D037  Return to caller

D038 ********** MAIN CODE ********************************************

  D038  Set recalibration count to 1
  D03D  Preserve sector number (D357)
  D040  Get "Unitnum"   DSSS0000
  D042  Strip out Drive 0SSS0000
  D044  Preserve slot number
  D046  Check for slot change, turn off motor if so <D69B>
  D049  See if motor is on <D4DA>
  D04C  Save test results
  D04F  Initialize counter for delay routine (D370)
  D054  See if slot or drive has changed (D359)
  D057  Update "current" unit number (D359)
  D05A  Save test results
  D05B  Put drive number in Carry flag
  D05C  Turn motor on (C089)
  D062  Select appropriate drive (C08A)
  D065  Check test results - Same slot/drive?
  D066  Yes, then skip delay >>D072
  D069  Wait for new Drive
  D06B  to come up to speed <D385>
  D072  Is command a status request?
  D074  Yes, then do not move disk arm >>D07C
  D076  Get track number for current request (D356)
  D079  And go there <D10C>
  D07C  Check test results - Was motor on?
  D07D  Yes, then skip delay >>D08E
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D07F
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D07F  Wait for Drive to
  D081  come up to speed <D385>
  D089  Is motor on yet? <D4DA>
  D08C  No, then exit with error >>D0EA
  D08E  Is command a "status" request?
  D090  Yes, then determine status >>D0FD
  D092  Is command a "read" request?
  D093  Yes, then continue on >>D098
  D095  Prepare data for write (prenibblize) <D5F0>
  D098  ---
  D09A  Initialize "retry" count at 64 (D369)
  D09D  ---
  D09F  Read an address field - Good read? <D398>
  D0A2  Yes, then continue on >>D0BE
  D0A4  Decrement "retry" count - More to try? (D369)
  D0A7  Yes, then try again >>D09D
  D0A9  No, just in case indicate "I/O Error"
  D0AB  Decrement "recalibration" count - More to try? (D36A)
  D0AE  No, then exit with error >>D0EA
  D0B0  Get "current" track (D35A)
  D0B3  Preserve it
  D0B4  Double it and
  D0B5  add 16 to it for recalibration
  D0B7  Reinitialize Retry Count
  D0BC  Branch always taken >>D0CC
  D0C1  Was the right track found? (D35A)
  D0C4  Yes, then continue on >>D0D5
  D0C6  Get "current" track (D35A)
  D0C9  Preserve it
  D0CA  Get track we found
  D0CB  Double it
  D0CC  Put new value in Device Track Table <D4D3>
  D0CF  Get track we want
  D0D0  And go there <D10C>
  D0D3  Branch always taken >>D09D
  D0D8  Was the right sector found? (D357)
  D0DB  No, then try again >>D0A4
  D0DF  Is command a "write" request?
  D0E0  Yes, then go do it >>D0F4
  D0E2  Read the data - Good read? <D3FD>
  D0E5  No, then try again >>D0A4
  D0E7  Indicate no errors
  D0E9  BNE Instruction, never taken
  D0EA  Indicate error
  D0EB  Preserve error number (D358)
  D0EE  Get Slot
  D0F0  Turn motor off (C088)
  D0F3   Return to caller
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D0F3
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------


D0F4 ********** HANDLE WRITE REQUEST **********************************

  D0F4  Write data - Good write? <D500>
  D0F7  Yes, then exit >>D0E7
  D0F9  Indicate "Write-protect error"
  D0FB  Branch always taken >>D0EA

D0FD ********** GET STATUS ****************************************

  D0FD  Get Slot number
  D102  Check "write-protect" status (C08E)
  D105  Put result in Carry flag
  D106  Select read mode (C08C)
  D109  Exit with appropriate status >>D0F7

D10C ********** LOCATE DESIRED TRACK **********************************

  D10C  Double the track number for proper phase
  D10D  Preserve destination track * 2 (D36F)
  D110  Turn all phases off <D125>
  D113  Get offset into Device Track Table <D4F1>
  D116  Get track (D359)
  D119  Update "current" track (D35A)
  D11C  Get destination track (D36F)
  D11F  Update Device Track Table (D359)
  D122  Move arm to desired track <D133>
  D125  Initialize phase number, starting with 3
  D127  ---
  D128  Clear a phase <D18A>
  D12B   Decrement phase number - More to do?
  D12C  Yes, then continue until all phases done >>D127
  D12E  Divide track number by 2 (D35A)
  D132  Return to caller

D133 ********** ARM MOVE ROUTINE **************************************

  D133  Preserve track to find (D372)
  D136  Are we already there? (D35A)
  D139  Yes, then set appropriate phase and exit >>D187
  D13D  Initialize phase count (halftracks) (D36B)
  D143  Preserve "current" track for comparisons (D371)
  D146  Subtract track to find to compute delta-tracks
  D147  Are we already there? (D372)
  D14A  Yes, then clear prior phase and exit >>D183
  D14C  Positive delta-tracks - go move arm out >>D155
  D14E  Negative delta-tracks - Get absolute value delta-tracks less 1
  D150  Increment current phase to move in (D35A)
  D153  Branch always taken >>D15A
  D155  Compute absolute value delta-tracks less 1
  D157  Decrement current phase to move out (D35A)
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86        NEXT OBJECT ADDR: D15A
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  D15A  Compare delta-tracks with phases moved (D36B)
  D15D  Use smaller value for offset to delay tables >>D162
  D162  Are we pointing at last table value yet?
  D164  Yes, then continue to use current offset  >>D168
  D166  Else, use new offset
  D167  Set Carry flag for set phase operation
  D168  Set a phase <D187>
  D16B  Get delay value from table (D373)
  D16E  Delay <D385>
  D171  Get prior phase number (D371)
  D174  Clear Carry flag for clear phase operation
  D175  Clear a phase <D18A>
  D178  Get delay value from table (D37C)
  D17B  Delay <D385>
  D17E  Increment phases moved (D36B)
  D183  Delay <D385>
  D187  Get "current" phase number (D35A)
  D18A  Use low two bits only, zero to three - 000000PP
  D18C  Multiply by two and bring in Carry   - 00000PPC
  D18D  Merge in slot number                 - 0SSS0PPC
  D18F  Put in X-reg for following operation
  D190  Toggle appropriate phase (C080)
  D193  Restore slot number to X-reg
  D195  Return to caller

D196 ********** TABLE 1 ***********************************************
         Read Translate Table with Prenibblize
         Bit mask Tables and Epilog Table in
         unused areas

  D196  Read Translate

          Bit Mask 1
  D1A0  00000000
  D1A1  10000000
  D1A2  01000000
  D1A3  11000000

  D1A4  Read Translate

          Bit Mask 2
  D1C0  00000000
  D1C1  00100000
  D1C2  00010000
  D1C3  00110000

  D1C4  Epilog Table ($DE,$AA,$EB)
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86        NEXT OBJECT ADDR: D1C4
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  D1C7   Read Translate

          Bit Mask 3
  D1E0  00000000
  D1E1  00001000
  D1E2  00000100
  D1E3  00001100

  D1E4  Read Translate

D200 ********** TABLE 2 ***********************************************

         Write Translate Table
                Every 4th byte starting at $D203

         Postnibblize Bit mask Tables
                Bit mask 1 (Every 4th byte starting at $D200
                Bit mask 2 (Every 4th byte starting at $D201
                Bit mask 3 (Every 4th byte starting at $D202

  D200  Entry for Bit Mask 1
  D201  Entry for Bit Mask 2
  D202  Entry for Bit Mask 3
  D203  Entry for Write Translate

D300 ********** AUXILIARY BUFFER ***************************************

  D300  Auxiliary Buffer ($56 bytes) >>0056

D356 ********** VARIABLE AREA ******************************************

  D356  Track number
  D357  Sector number
  D358  Error number

          Disk Device Track Table
D359    Table Entry
  D359  Current Unit
  D35A  Current Track
  D35B  Slot 1, Devices 1 & 2
  D35D  Slot 2, Devices 1 & 2
  D35F  Slot 3, Devices 1 & 2
  D361  Slot 4, Devices 1 & 2
  D363  Slot 5, Devices 1 & 2
  D365  Slot 6, Devices 1 & 2
  D367  Slot 7, Devices 1 & 2
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D367
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D369  Retry count (initially 64)
  D36A  Recalibration count (initially 1)
D36B    Counter for Read Address routine
D36B    Temporary storage for Read Address routine
  D36B  Track counter for Arm Move routine
  D36C  Checksum computation
  D36D  Volume found
  D36E  Sector found
D36F    Delay counter (low byte)
  D36F  Track found
D370    Checksum found
  D370  Delay counter (high byte)
  D371  Prior Track
  D372  Track number for Arm Move routine

D373 ********** PHASEON/PHASEOFF TABLES ******************************

  D373  Phase on table (delays for disk head acceleration)

  D37C  Phase off table (delays for disk head deacceleration)

D385 ********** WAIT ROUTINE ****************************************

  D385  Wait about 100 times A-register (microseconds)
  D387  ---
  D392  ---
  D397  Return to caller

D398 ********** READ ADDRESS FIELD **********************************

  D398  Initialize "must find" count at $FCFC
  D39D  Increment count (low order byte) - Zero yet?
  D39E  No, skip ahead >>D3A5
  D3A0  Increment count (high order byte) - Zero yet? (D36B)
  D3A3  Yes, exit and indicate Read Error >>D3FB
  D3A5  Read data register (C08C)
  D3A8  Loop until data valid  >>D3A5
  D3AA  Is it first address mark ($D5)?
  D3AC  No, then increment "must find" count >>D39D
  D3AE  Delay for data latch to clear
  D3AF  Read data register (C08C)
  D3B2  Loop until data valid >>D3AF
  D3B4  Is it second address mark ($AA)?
  D3B6  No, then see if it's first address mark >>D3AA
  D3B8  Initialize count for four byte read
  D3BA  Read data register (C08C)
  D3BD  Loop until data valid >>D3BA
  D3BF  Is it third address mark ($96)?
  D3C1  No, then see if it's first address mark >>D3AA
  D3C3  Set Interupt flag
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D3C4
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D3C4  Initialize checksum
  D3C9  Read "odd" encoded byte     1X1X1X1X (C08C)
  D3CE  Align "odd" bits            X1X1X1X1
  D3CF  Save for later (D36B)
  D3D2  Read "even" encoded byte    1X1X1X1X (C08C)
  D3D7  Combine bytes               XXXXXXXX (D36B)
  D3DA  Preserve data (Volume,Track,Sector,Checksum) (D36D)
  D3DD  Do checksum computation (D36C)
  D3E0  Decrement counter - Finished field yet?
  D3E1  No, do some more >>D3C6
  D3E3  Is checksum computation zero?
  D3E4  No, then exit with carry set >>D3FB
  D3E6  Read data register (C08C)
  D3E9  Loop until data valid >>D3E6
  D3EB  Is it first trailing byte ($DE)?
  D3ED  No, then exit with carry set >>D3FB
  D3EF  Delay for data latch to clear
  D3F0  Read data register (C08C)
  D3F3  Loop until data vaild >>D3F0
  D3F5  Is it second trailing byte ($AA)?
  D3F7  No, then exit with carry set >>D3FB
  D3F9  Clear the Carry flag (no error)
  D3FA  Return to caller
  D3FB  Set the Carry flag (error occured)
  D3FC  Return to caller

D3FD ********** READ DATA (ON THE FLY) ROUTINE  **********************

  D3FD  Convert slot number to an
  D3FE  absolute reference (i.e. $60 -> $EC)
  D400  Modify code for current slot number (D45A)
  D403  (i.e. $C08C,X -> $C0EC) (D473)
  D40F  Get data buffer pointers
  D413  Modify code for current Buffer address (D4AF)
  D416  Provides access to top 3rd of Buffer (D4B0)
  D41A  Subtract $54 from current address
  D41F  Modify code for current address - $54  (D497)
  D422  Provides access to middle 3rd of Buffer (D498)
  D426  Subtract $57 from current address
  D42B  Modify code for current address - $AB (D470)
  D42E  Provides access to bottom 3rd of Buffer (D471)

  D431  Initialize must find count at $20
  D433  Decrement count - More to do?
  D434  No, then exit >>D46D
  D436  Read data register (C08C)
  D439  Loop until data valid >>D436
  D43B  Is is 1st header mark ($D5)?
  D43D  No, then try again >>D433
  D43F  Delay for register to clear
  D440  Read data register (C08C)
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86        NEXT OBJECT ADDR: D443
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D443  Loop until data valid >>D440
  D445  Is is 2nd header mark ($AA)?
  D447  No, then see if it is 1st header mark >>D43B
  D449  Delay for register to clear
  D44A  Read data register (C08C)
  D44D  Loop until data valid >>D44A
  D44F  Is is 3rd header mark ($AD)?
  D451  No, then see if it is 1st header mark >>D43B
  D453  Initialize offset into data buffer
  D457  Initialize checksum
  D459  Read a data byte (C0EC)
  D45E  Translate it (D100)
  D461  Store it in Auxiliary buffer (D256)
  D464  Compute running checksum
  D466  Increment offset - More to do?
  D467  Yes, then continue >>D457
  D469  Reinitialize offset into data buffer
  D46B  Branch always taken >>D472
  D46D  Set carry flag indicating error
  D46E  Return to caller
  D46F  Store byte in Primary buffer (bottom third) (1000)
  D472  Read a data byte (C0EC)
  D477  Translate it and merge in (D100)
  D47A  bits from Auxiliary buffer (D256)
  D480  Increment offset - done yet?
  D481  No, then do another >>D46F
  D483  Save last byte for later, no time now
  D484  Strip off last two bits   XXXXXX00
  D486  Reinitialize offset
  D488  Read a byte (C0EC)
  D48D  Translate it and merge in (D100)
  D490  bits from Auxiliary buffer (D256)
  D496  Store byte in Primary buffer (middle third) (1000)
  D499  Increment offset - done yet?
  D49A  No, then do another >>D488
  D49C  Read a byte (C0EC)
  D4A1  Strip off last two bits   XXXXXX00
  D4A3  Reinitialize offset
  D4A5  Translate byte and merge in (D100)
  D4A8  bits from Auxiliary buffer (D254)
  D4AE  Store byte in Primary buffer (top third) (1000)
  D4B1  Read a byte (C0EC)
  D4B6  Increment offset - done yet?
  D4B7  No, then do another >>D4A5
  D4B9  Strip off last two bits   XXXXXX00
  D4BB  Is checksum valid? (D100)
  D4BE  No, then exit with error >>D4CC
  D4C0  Get slot number
  D4C2  Read data register (C08C)
  D4C5  Loop until data valid >>D4C2
  D4C7  Is it 1st trailing mark ($DE)?
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86        NEXT OBJECT ADDR: D4CA
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D4CA  Yes, then continue with carry clear >>D4CD
  D4CC  Set Carry flag indicating error
  D4CD  Get byte we stored away, we have time now
  D4CE  Set proper offset
  D4D0  Store byte in Primary buffer (offset $55)
  D4D2  Return to caller

D4D3 ********** UPDATE DEVICE TRACK TABLE ****************************

  D4D3  Get offset into Device Track Table <D4F1>
  D4D6  Update Device Track Table (D359)
  D4D9  Return to caller

D4DA ********** DETERMINE IF DRIVE IS ON (DATA CHANGING)**************

  D4DA  Get slot number
  D4DC  Initialize counter
  D4DE  Read data register (C08C)
  D4E1  Delay 25 cycles <D4F0>
  D4E6  Has data register changed? (C08C)
  D4E9  Yes, then exit >>D4F0
  D4EB  Just in case indicate No Device Connected Error
  D4ED  Decrement count - 256 tries yet?
  D4EE  No, try again >>D4DE
  D4F0  Return to caller

D4F1 ********** CONVERT SLOT/DRIVE TO TABLE OFFSET ******************

  D4F1  Preserve A-register
  D4F2  Get Unit number        DSSS0000
  D4F4  Divide by 16           0000DSSS
  D4F8  Put Drive into Carry   0000DSSS  D
  D4FA  Strip out Drive        00000SSS  D
  D4FC  Roll left              0000SSSD
  D4FD  Put result in X-register
  D4FE  Restore A-register
  D4FF  Return to caller

D500 ********** WRITE DATA ROUTINE ***********************************

  D500  Set Carry flag (anticipate error)
  D504  Is diskette "write-protected"? (C08E)
  D507  No, then continue on >>D50C
  D509  Go to error routine >>D5DF
  D50C  Put transition byte from secondary buffer (D300)
  D50F  into zero page for timing
  D511  Use $FF for "sync" byte
  D513  Write first "sync" byte (C08F)
  D519  Set counter for four more
  D51C  Delay so that writes occur
  D51D  Exactly on 40 cycle loops
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D51E
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D51E  ---
  D520  Write "sync" byte <D5E7>
  D523  Decrement counter, done yet?
  D524  No, then do another >>D51E
  D526  Write first data mark ($D5)
  D52B  Write second data mark ($AA)
  D530  Write third data mark ($AD)
  D535  Initialize checksum
  D536  Initialize index into Auxiliary buffer
  D538  Branch always taken >>D53D
  D53A  Get data byte (Auxiliary buffer) (D300)
  D53D  Exclusive-or with previous data byte (D2FF)
  D540  Put result in X-reg for table lookup
  D541  Lookup "disk byte" in table (D203)
  D544  Get slot
  D546  Write "disk byte" (C08D)
  D54C  Decrement index - Done with Auxiliary buffer?
  D54D  No, then another byte >>D53A
  D54F  Get last byte of Auxiliary buffer
  D551  Initialize index into Primary buffer
  D553  Exclusive-or with next data byte (1000)
  D556  Strip out last two bits  XXXXXX00
  D558  Put result in X-reg for table lookup
  D559  Lookup "disk byte" in table (D203)
  D55C  Get slot
  D55E  Write "disk byte" (C08D)
  D564  Get data byte (Primary buffer) (1000)
  D567  Increment offset, end of this page?
  D568  No, then continue on >>D553
  D56A  Did buffer start on page boundary?
  D56C  Yes, then go write checksum >>D5C0
  D56E  Did buffer start one past page boundary?
  D570  Yes, then go write last byte >>D5B3
  D572  Carry indicates odd or even buffer end
  D573  Get transition byte
  D575  Write it (C08D)
  D57B  Get second transition byte
  D57D  Delay 2 cycles for correct timing
  D57E  Increment offset, buffer end on odd byte?
  D57F  Yes, go see if we're done then >>D599
  D581  Exclusive-or with next data byte (1100)
  D584  Strip out last two bits  XXXXXX00
  D586  Put result in X-reg for table lookup
  D587  Lookup "disk byte" in table (D203)
  D58A  Get slot
  D58C  Write "disk byte" (C08D)
  D592  Get data byte (Primary buffer - page 2) (1100)
  D595  Increment offset
  D596  Exclusive-or with next data byte (1100)
  D599  End of buffer? - Put result in carry
  D59B  Strip out last two bits  XXXXXX00
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86       NEXT OBJECT ADDR: D59D
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D59D  Put result in X-reg for table lookup
  D59E  Lookup "disk byte" in table (D203)
  D5A1  Get slot
  D5A3  Write "disk byte" (C08D)
  D5A9  Get data byte (Primary buffer - page 2) (1100)
  D5AC  Increment offset - Done yet?
  D5AD  No, then do another >>D581
  D5AF  Yes, then go write checksum >>D5B1
  D5B1  --- >>D5C0
  D5B3  Get last byte
  D5B6  Write it (C08D)
  D5BC  Delay 14 cycles for correct timing
  D5C0  Use last byte in Primary buffer as checksum
  D5C2  Lookup "disk byte" (D203)
  D5C5  Get slot
  D5C7  Write "disk byte" (C08D)
  D5CD  Initialize offset into "epilog" table
  D5CF  Delay 11 cycles for correct timing
  D5D3  Load "epilog" from table ($DE,$AA,$EB,$FF) (D1C4)
  D5D6  Go write it <D5E9>
  D5D9  Increment offset
  D5DA  Done all four yet?
  D5DC  No, then do another >>D5D3
  D5DE  Clear Carry flag (no error)
  D5DF  Select read mode (C08E)
  D5E5  Return to caller

D5E6 ********** WRITE A BYTE SUBROUTINE ******************************

  D5E6  Wait 9 cycles before write
  D5E7  Wait 7 cycles before write
  D5E9  Put A-register in data register (C08D)
  D5EC  And write data register (C08C)
  D5EF  Return to caller

D5F0 ********** PRENIBLIZE BLOCK ROUTINE *****************************

  D5F0  Get buffer pointer
  D5F5  Add $2 to buffer address
  D5F7  To access top third of buffer >>D5FA
  D5FA  Store result in code below (D630)
  D601  Subtract $54 from buffer address
  D603  To access middle third of buffer >>D606
  D606  Store result in code below (D625)
  D60D  Subtract $AA from buffer address
  D60F  To access bottom third of buffer >>D612
  D612  Store result in code below (D61B)
  D618  Initialize offset
  D61A  Get data byte (bottom third)    XXXXXXXX (1000)
  D61D  Get last two bits               000000AB
  D61F  Put in X-reg for table lookup
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86        NEXT OBJECT ADDR: D620
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D620  Use lookup to reposition bits    0000BA00 (D1E0)
  D623  Save result on stack
  D624  Get data byte (middle third)     XXXXXXXX (1056)
  D627  Get last two bits                000000CD
  D629  Put in X-reg for table lookup
  D62A  Get current value from stack     0000BA00
  D62B  Merge in new bits using table    00DCBA00 (D1C0)
  D62E  Save result on stack
  D62F  Get data byte (top third)        XXXXXXXX (10AC)
  D632  Get last two bits                000000EF
  D634  Put in X-reg for table lookup
  D635  Get current value from stack     00DCBA00
  D636  Merge in new bits using table    FEDCBA00 (D1A0)
  D639  Save result on stack
  D63A  Get offset into primary buffer
  D63B  Compute offset into Auxiliary buffer
  D63D  Put in X-reg
  D63E  Get data byte just created       FEDCBA00
  D63F  Store it in Auxiliary buffer (D300)
  D642  Increment offset primary buffer, done yet?
  D643  No, then do another >>D6IA
  D645  Get low order byte of buffer
  D647  Subtract 1 (offset to last byte in buffer)
  D648  Save it for later
  D64A  Get low order byte of buffer
  D64C  Modify code in Write Data Routine (offset) (D552)
  D64F  Buffer on page boundary? - Yes, skip ahead >>D65F
  D651  Else, compute offset to last byte
  D653  Before page boundary
  D654  Get byte (page boundary -1)
  D656  Point at next byte (page boundary)
  D657  Exclusive-or them together       XXXXXXXX
  D659  Strip off last two bits          XXXXXX00
  D65B  Put in X-reg for table lookup
  D65C  Get "disk byte" from table (transition byte) (D203)
  D65F  Save result (0 indicates page boundary)
  D661  Buffer on page boundary? - Yes skip ahead >>D66F
  D663  Get offset to last byte in buffer
  D665  Carry indicates odd or even buffer start
  D666  Get byte (page boundary)
  D668  Did buffer start on odd byte? - Yes skip >>D66D
  D66A  Point at next byte (page boundary +1)
  D66B  Exclusive-or them together
  D66D  Save result
  D66F  Point at last byte in buffer
  D671  Get last byte in buffer          XXXXXXXX
  D673  Strip off last two bits          XXXXXX00
  D675  Save result ("checksum byte")
  D677  Get high order byte of buffer
  D679  Modify code in Write Data Routine (D555)
  D68C  Get slot number for this operation
```

```
Disk II Device Driver -- V1.2 -- 6 SEP 86        NEXT OBJECT ADDR: D68E
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  D68E  Modify code in Write Data Routine (D55D)
  D69A  Return to caller

D69B ********** DETERMINE IF SLOT/DRIVE HAS CHANGED ******************

  D69B  Compare unit number with "current" unit number (D359)
  D69E  Put "current" drive in Carry
  D69F  Has slot changed? - No, then exit >>D6BD
  D6A9  Get "current" slot
  D6AB  Put in X-register
  D6AC  Exit if Slot 0 >>D6BD
  D6AE  Is "current" motor is on? <D4DC>
  D6B1  No, then exit >>D6BD
  D6B8  Wait until "current" motor is off (D370)
  D6BB  Or else timeout >>D6A6
  D6BD  Return to caller

D6BE ******** CLEAR IWM PHASES ***************************************

  D6BE  Get unit number
  D6C0  Strip drive bit
  D6C2  Put slot*16 in X-Register
  D6C3  Clear phases in case there is (C080)
  D6C6  one of them new-fangled storage (C082)
  D6C9  devices sharing this slot  (C084)
  D6CC  with my (t)rusty old Disk II. (C086)
  D6CF  Return to caller

D6D0 ********** CHECK CALLING PARAMETERS ******************************
            Note: For 40-track drives, change byte at $D6E3
                  from $18 to $40

  D6D0  Check command code
  D6D2  Is it greater or equal to 4?
  D6D4  Yes, indicate error >>D6E6
  D6D6  Get Block Number
  D6DA  Is Block Number good? (D356)
  D6DD  Yes, if less than $100 >>D6E8
  D6E0  No, if greater than or equal to $200 >>D6E6
  D6E4  No, if greater than or equal to $118 >>D6E8
  D6E6  Indicate error
  D6E7  Return to caller
  D6E8  All is well
  D6E9  Return to caller

D6EA ******** $D6EA-$D6FF NOT USED **********************************

  D6EA  Not used
```

```
Disk II Device Driver -- V1.3 -- 2 DEC 86       NEXT OBJECT ADDR: D6BE
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

        ****************************************
        *                                      *
        *  5.25" DISK DEVICE DRIVER            *
        *                                      *
        *      RESIDES AT $D000-$D6FF          *
        *                                      *
        *  VERSION 1.3 -- 2 DEC 86             *
        *                                      *
        ****************************************

         The Disk II Device Driver for Version 1.3 changes only
         in one routine--the "clear phases" subroutine.
         Phases are now cleared with a "LDA" instead of
         a "STA" to eliminate bus fights that potentially cause
         unwanted writing to the 5.25" disk.

D6BE ******** CLEAR IWM PHASES ***************************************

  D6BE  Get unit number
  D6C0  Strip drive bit
  D6C2  Put slot*16 in X-Register
  D6C3  Turn off 8 phases
  D6CF  Return to caller

D6D0 ********** CHECK CALLING PARAMETERS ******************************
           Note: For 40-track drives, change byte at $D6E3
                 from $18 to $40.

  D6D0  Check command code
  D6D2  Is it greater or equal to 4?
  D6D4  Yes, indicate error >>D6E6
  D6D6  Get Block Number
  D6DA  Is Block Number good? (D356)
  D6DD  Yes, if less than $100 >>D6E8
  D6E0  No, if greater than or equal to $200 >>D6E6
  D6E4  No, if greater than or equal to $118 >>D6E8
  D6E6  Indicate error
  D6E7  Return to caller
  D6E8  All is well
  D6E9  Return to caller

D6EA ******** $D6EA-$D6FF NOT USED **********************************

  D6EA  Not used
```

```
IRQ Handler -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: FF9B
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FF9B    MODULE STARTING ADDRESS
            ************************************
            *                                  *
            * IRQ Handler                      *
            *     Resides at $FF9B.  Put       *
            *     there by ProDOS Relocator.   *
            *                                  *
            * VERSION 1.2 -- 6 SEP 86          *
            * VERSION 1.3 -- 2 DEC 86          *
            * (The IRQ Handler is still the    *
            *  same as it was in Version 1.0.1) *
            *                                  *
            ************************************

FF9B ********** GLOBAL PAGE EQUATES **********************************

BF56    Temporary storage 1
BF57    Temporary storage 2
BF88    A register savearea
BF8D    Bank ID byte
BFD3    IRQ exit code

FF9B ********** EXTERNAL EQUATES ***************************************

D000    RAM/ROM test byte
C082    ROM Select
C08B    BANK1 Select

FF9B ********** IRQ CODE *********************************************

  FF9B  Put A-Register on stack
  FF9C  Get Accumulator value from $45
  FF9E  and save it (BF56)
  FFA1  Replace $45 with A-Register
  FFA2  since it may have been destroyed
  FFA4  Load Status register
  FFA5  Restore onto stack
  FFA6  Isolate B flag - Was it a BRK?
  FFA8  Yes, skip Interrupt stuff >>FFC2
  FFAA  Else, Check location $D000 (D000)
  FFAD  Do we have RAM active
  FFAF  Yes, indicate so >>FFB3
  FFB1  Else, indicate ROM
  FFB3  Update Bank ID byte (BF8D)
  FFB6  Also save temporarily (BF57)
  FFB9  Push ($BF50) address of
  FFBB  routine to bank in Ram and
  FFBC  call IRQ on the stack
  FFBF  Push a new P-Register on stack with
  FFC1  the Interrupt Disable flag set
  FFC2  Push ($FA41) address less 1 of
```

```
IRQ Handler -- V1.2 -- 6 SEP 86                NEXT OBJECT ADDR: FFC4
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FFC4  Monitor IRQ on the stack
  FFC8  Select ROM - execution continues in ROM (C082)

            ******* RESET CODE ****************

  FFCB  Push ($FA61) address less 1 of (FFD7)
  FFCE  Hardware Reset routine on to stack
  FFD3  Exit via select ROM code above >>FFC8

  FFD6  Address (-1) of Hardware Reset routine

            ******* IRQ CODE ******************
          Called via $BF50 in System Global Page

  FFD8  Save Accumulator in Global page (BF88)
  FFDB  Restore $45 with original value (BF56)
  FFE0  Select RAM (read & write) (C08B)
  FFE3  use BANK1 (C08B)
  FFE6  Get Bank ID byte (BF57)
  FFE9  Leave via Global Page IRQ exit code >>BFD3

FFEC *********** $FFEC-$FFF9 UNUSED **********************************

  FFEC  These unused bytes are at $4FEC-$4FF9 when
  FFF9  loaded as part of the "PRODOS" file.

FFFA ********** VECTORS ***********************************************

  FFFA  NMI Vector
  FFFC  Reset Vector
  FFFE  IRQ Vector
```

```
ThunderClock Code -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: D742
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

D742    MODULE STARTING ADDRESS

            ************************************
            *                                  *
            * CLOCK Code (for ThunderClock)    *
            *     If a ThunderClock or its     *
            *     equivalent is located, then  *
            *     this code is loaded into the *
            *     ProDOS data area at $D742.   *
            *                                  *
            * VERSION 1.2 -- 6 SEP 86, and     *
            * VERSION 1.3 -- 2 DEC 86          *
            *                                  *
            ************************************

D742 ********** ZERO PAGE EQUATES ***********************************

003A    Binary month (1=JAN, 2=FEB, etc.)
003B    Binary day of week (0=Sunday, 1=Monday, etc.)
003C    Binary day of the month (1-31)
003D    Binary hour of the day (0-23)
003E    Binary minute of the hour (0-59)

D742 ********** EXTERNAL EQUATES *************************************

0200    Input Buffer
BF90    Global page year-month-day
BF92    Global page hours-minutes

D742 ********** CLOCK CODE ENTRY POINT *******************************

  D742  Get slot ROM high byte (D750)
  D745  Get a screen hole byte for this slot (0538)
  D748  and save it on the stack
        The two JSR addresses that follow will be
        modified by ProDOS Relocator so that they
        will access the correct slot ROM.
  D74B  Write an $A3 to the clock (consult your Thunderclock manual) <C10B>
  D74E  Read the clock. <C108>
        Reading the clock results in an ASCII string
        being placed in the input buffer.  A sample
        string might be "07,06,04,22,46,57", which is
        July (month 07) Saturday (day-of-week 6)
        the 4th (day of month 4) 10 PM (hour 22)
        46 minutes and 57 seconds after the hour.
```

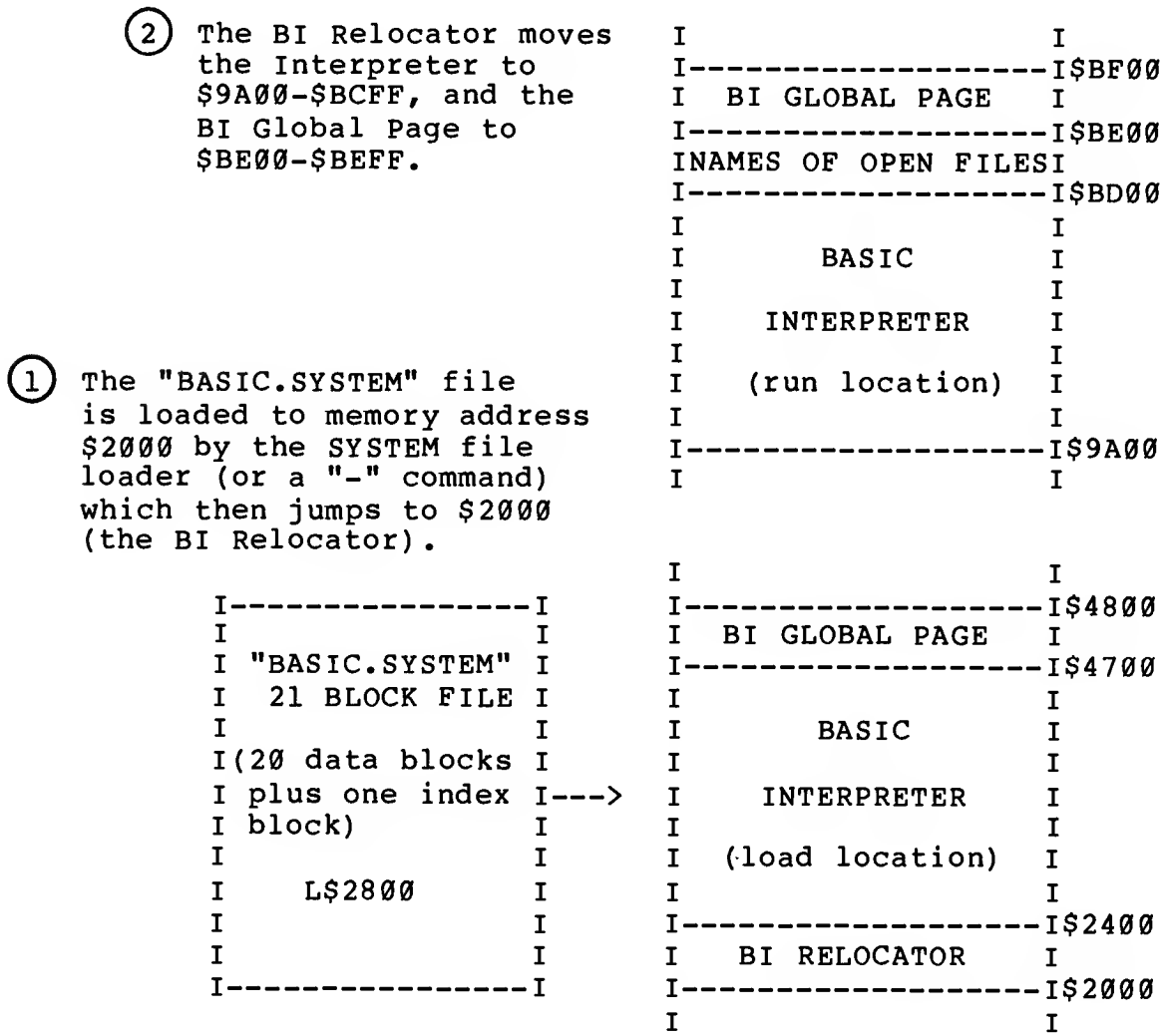
```
ThunderClock Code -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: D751
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

D751 ******* CONVERT ASC11 TO BINARY *********************************

  D751  ---
  D752  Five values to convert (ProDOS ignores seconds)
  D754  Y-reg is index into
  D756  the input buffer (0200)
  D759  Strip ASC11 from ten's digit
  D75D  by 10
  D762  Add in one's digit (0201)
  D766  and subtract off ASC11,
  D768  then store as binary in Z-page
  D76A  Skip over comma
  D76B  and two digits
  D76E  More values to convert >>D756

D770 ******* NOW CONVERT TO PRODOS DATE, TIME ************************

  D770  Save month in Y-reg
  D771  three low bits of month
  D774  three high bits of accum,
  D775  combine with day of month,
  D777  and store in low byte of DATE (MMMDDDDD) (BF90)
  D77A  Save carry (high bit of month)
  D77B  Add day of the month
  D77D  to table value to get Julian date (D7AB)
  D780  Late September? >>D784
  D782  Yes, add 3 and carry (see notes below)
  D784  Compute Julian date MOD 7
  D785  ---
  D78B  Subtract day-of-week to get year index
  D78D  Index positive? >>D791
  D78F  No, make it positive
  D791  Index to Y-Reg
  D792  Get year from year table (D7B8)
  D795  Get high bit of month in carry
  D796  roll it into accumulator
  D797  to get high byte of DATE (YYYYYYYM) (BF91)
  D79A  Put hour
  D79C  in high byte of TIME (BF93)
  D79F  Put minutes
  D7A1  in low byte of TIME (BF92)
  D7A8  Restore saved screen hole value (0538)
  D7AB  RETURN

D7AC ******* JULIAN TABLE ****************************************

  D7AC  January
  D7AD  February
  D7AE  March
  D7AF  April
  D7B0  May
```

```
ThunderClock Code -- V1.2 -- 6 SEP 86          NEXT OBJECT ADDR: D7B1
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  D7B1  June
  D7B2  July
        If month>7, value in table is one
        less than Julian, because a carry
        is added along with the day of the month
  D7B3  August
  D7B4  September
         Note: For Julian dates>255, the table value
               is three more than the low byte should be,
               so that it will properly divide by 7.
  D7B5  October
  D7B6  November
  D7B7  December

D7B8 ******* YEAR TABLE *********************************************
        This table is good for the years 1986-91

  D7B8  1990
  D7B9  1989
  D7BA  1988 (March to December)
  D7BB  1988 (January and February)
  D7BC  1987
  D7BD  1986
  D7BE  1991
```

```
IIGS Clock Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: D742
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

D742    MODULE STARTING ADDRESS

        ***********************************
        *                                 *
        * IIGS CLOCK Code                 *
        *    If ProDOS 8 is booted on     *
        *    an Apple IIGS, then this     *
        *    code is loaded into the      *
        *    ProDOS data area at $D742.   *
        *                                 *
        * VERSION 1.2 -- 6 SEP 86, and    *
        * VERSION 1.3 -- 2 DEC 86         *
        *                                 *
        ***********************************

D742 ******** GLOBAL PAGE VALUES ************************************

BF90    ProDOS DATE word, YYYYYYYMMMMDDDDD.
BF92    ProDOS TIME word, 000HHHHH00MMMMMM.

D742 ******** IIGS SOFT SWITCH *************************************

C068    One byte sets 8 soft switches.

D742 ******** CLOCK CODE ENTRY POINT *******************************

  D742  8-bit memory and index operations.
  D744  Get IIGS STATEREG Status Byte,  (C068)
  D747  save it temporarily.  (D790)
  D74A  Make sure we're in bank 0.
  D750  Get out of emulation mode.
  D751  16-bit memory and index operations.
  D756  Push 4 null words on the stack.
  D75A  Tool = ReadTimeHex.  (0D03)
  D75D  Jump to the tool dispatcher.  <E10000>
  D761  8-bit memory operations.
  D763  Get pre-call Status Byte  (D790)
  D766  and restore all soft switches.  (C068)
  D769  Throw away seconds.
  D76B  Store minutes in ProDOS Global Page.  (BF92)
  D76F  Store hours in ProDOS Global Page.  (BF93)
  D772  Get year
  D773  and store it temporarily.  (BF91)
  D776  Get day of month
  D777  in range 1-31
  D778  and save it temporarily.  (BF90)
  D77B  Get month
  D77C  in range 1-12
  D77D  and shift it left five bits.
  D782  Combine with the date  (BF90)
  D785  and store in Global Page as MMMDDDDD.  (BF90)
```

```
IIGS Clock Code -- V1.2 -- 6 SEP 86            NEXT OBJECT ADDR: D788
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  D788  Roll high bit of month into year to put  (BF91)
         YYYYYYYM in Global Page.
  D78B  Throw away day of week
  D78C  and null byte.
  D78E  Back to emulation mode.
  D78F  RETURN

  D790  Saved STATEREG Byte.

  D791  Vanity code.

  D7A1  $D7A1 to $D7BE not used, set to 0.
```

HOW "BASIC.SYSTEM" IS LOADED AND RELOCATED



3 The BI Relocator searches for a "STARTUP" file in the same directory as "BASIC.SYSTEM". If found, it loads and executes the "STARTUP" program. Otherwise, it prints out a greeting and cold starts BASIC by jumping to the BASIC entry point at $BE00.

```
BI Relocator -- VI.1 -- I8 JUN 84              NEXT OBJECT ADDR: 2000
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

2000    MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  PRODOS BASIC INTERPRETER RELOCATOR  *
          *       LOADED AS THE FIRST TWO BLOCKS *
          *       OF BASIC.SYSTEM AT $2000.      *
          *       THIS ROUTINE MOVES THE BASIC   *
          *       INTERPRETER TO $9A00-$BCFF.    *
          *                                      *
          *  BASIC VERSION 1.I -- I8 JUN 84      *
          *                                      *
          *  DISTRIBUTED WITH PRODOS 8 VERSIONS  *
          *     1.I.I, I.2, and I.3.             *
          *                                      *
          ****************************************

          ******** ZERO PAGE ADDRESSES ************

0000    "FROM" POINTER FOR COPY
000I
0002    "TO" POINTER FOR COPY
0003
0036    CSWL VECTOR
0038    KSWL VECTOR
006F    APPLESOFT START OF STRINGS
0073    APPLESOFT HIMEM
00F2    APPLESOFT TRACE FLAG

          ******** EXTERNAL ADDRESSES *************

0200    PATHNAME BUFFER
0280    PREFIX BUFFER
0281    START OF PREFIX NAME

03D0    WARMSTART VECTOR
03D3    COLDSTART VECTOR
03F0    BRK HANDLER ADDRESS
03F1
03F2    RESET HANDLER ADDRESS
03F3
03F4    POWER-UP BYTE
03F5    APPLESOFT & VECTOR
03F8    CTL-Y VECTOR

          ******** SCREEN LINE ADDRESSES **********
```

```
BI Relocator -- VI.I -- I8 JUN 84              NEXT OBJECT ADDR: 2000
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

0400    FIRST SCREEN BUFFER LINE
0480    SCREEN BUFFER LINE
0628    SCREEN BUFFER LINE

          ******** BASIC GLOBAL PAGE **************

BC7A    BASIC INTERPRETER VERSION NUMBER
BE00    BASIC INTERPRETER ENTRY POINT
BE03    BI COMMAND SCANNER (SYNTAX)
BE10    COUT VECTORS FOR EACH SLOT
BE20    KSWL VECTORS FOR EACH SLOT
BE3C    DEFAULT SLOT NO.
BE3D    DEFAULT DRIVE NO.
BEFB    HIMEM

          ******** SYSTEM GLOBAL PAGE *************

BF00    MACHINE LANGUAGE INTERFACE ENTRY
BF30    LAST DEVICE USED
BF58    MEMORY MAP
BF98    MACHINE TYPE FLAGS
BF99    SLOTS WHICH CONTAINS CARDS WITH ROM
BF9A    IF 0, NO PREFIX ACTIVE
BFFD    INTERPRETER VERSION NUMBER

          ******** ROM ADDRESSES ******************

E000    APPLESOFT ENTRY POINT
FA59    BRK HANDLER
FB2F    INIT SCREEN, MONITOR, ETC.
FC58    CLEAR SCREEN, HOME CURSOR
FDED    STANDARD CHARACTER OUT
FDF0    CHARACTER OUTPUT TO SCREEN
FE84    SET NORMAL CHARACTER ATTRIBUTE

2000 *********** BASIC INTERP RELOCATOR ENTRY ************************

  2000  JUMP OVER STARTUP FILENAME >>2047
  2006  STARTUP FILENAME LENGTH (7)
  2007  'STARTUP'
  200E  ALLOW FOR 64 CHAR FILENAME

  2047  $00 --> $2400
  204B  $02 --> $9A00
  2055  COPY 35 PAGES
  2058  COPY INTERP TO HIGH MEMORY AT $9A00 <20C4>
  205D  PAGE FOLLOWING INTERP IMAGE IS...
  205F  BASIC GLOBAL PAGE IMAGE
  2061  COPY THAT TO $BE00 <20C4>
  2064  TO GET 40-COL DISPLAY, SEND A CTRL-U
```

```
BI Relocator -- V1.1 -- 18 JUN 84              NEXT OBJECT ADDR: 2066
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2066  OUT THE NORMAL OUTPUT VECTOR. <FDED>
  2069  SET NORMAL CHARACTER ATTRIBUTE <FE84>
  206C  INITIALIZE SCREEN/WINDOW <FB2F>
  206F  CLEAR SCREEN/HOME CURSOR  <FC58>
  2076  SET BITMAP TO MARK LOWER 48K FREE (BF58)
  207C  EXCEPT PAGES 0 AND 1 AND
  207E   TEXT PAGES 4 THROUGH 7 (BF58)
  2086  MARK $9000-$BFFF IN USE..
  2091  EXCEPT FOR $BA00-$BDFF ARE FREE
  2096  LOOK AT LANGUAGE IN ROM (E000)
  2099  IS IT APPLESOFT?
  209B  NO, THEN CAN'T RUN INTERP >>20B1
  20A0  GOT AT LEAST 64K?
  20A2  NO, THIS ONLY WORKS IN 64K >>20B1
  20A6  SET MY CSWL/KSWL FOR INTERP INIT (221A)
  20AC  COPY ALL 4 BYTES >>20A6
  20AE  THEN GO TO BASIC COLDSTART >>E000
          (WE WILL GET CONTROL AT $20D4 AGAIN)

20B1 *********** ERROR EXIT ***************************************

  20B1  ---
  20B3  PRINT "UNABLE TO EXECUTE BASIC SYSTEM" (223F)
  20BC  ALLOW REBOOT IF RESET PRESSED (03F4)
  20C2  GO TO SLEEP FOREVER >>20C2

20C4 *********** COPY PAGES ($0/1-->$2/3) ****************************

  20C4  ---
  20C5  COPY FROM $0/1
  20C7  TO $2/3
  20CA  A PAGE AT A TIME >>20C4
  20D0  COUNT PAGES
  20D3  RETURN

20D4 *********** CSWL INTERCEPT / CONTINUE ***************************

  20D4  "]" APPLESOFT PROMPT?
  20D6  NO...DON'T PRINT WHATEVER IT IS >>20D3
  20D8  YES, APPLESOFT DONE SETTING UP (BE10)
  20DB  POINT CSWL TO STANDARD OUTPUT
  20E2  CHECK LAST DEVICE USED (BF30)
  20E5  SET ONLINE PARAMETER TO THIS (2238)
  20EB  DRIVE ONE OR TWO? >>20EE
  20EE  STORE DEFAULT DRIVE (D) (BE3D)
  20F2  ISOLATE SLOT FROM DEVICE NO.
  20F7  AND STORE DEFAULT SLOT (S) (BE3C)
  20FE  GET SLOT BYTE SHOWING CARDS PRESENT (BF99)
  2102  PICK OFF ITS BITS ONE BY ONE
  2108  SET OUTVECS AND INVECS TO $CS00 (BE10)
  210B  FOR ALL SLOTS WITH ROMS IN THEM (BE20)
```

```
BI Relocator -- V1.1 -- 18 JUN 84              NEXT OBJECT ADDR: 2115
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  2115  ---
  211B  SET HIMEM TO $9600
  211D  IN VARIOUS PLACES
  2124  GOT A DEFAULT PREFIX? (BF9A)
  2127  NO >>214E
  2129  YES, MLI: GET PREFIX <BF00>
  212F  ERROR? >>218B
  2136  BACKSCAN PREFIX FOR "/"'S (0280)
  213B  AND COUNT THEM IN $223E (223E)
  213E  ---
  213F  FOR A COUNT OF SUBLEVELS >>2136
  2146  MORE THAN JUST VOLUME NAME? >>216F
  2148  NO, ML1: SET PREFIX <BF00>
  214E  ML1: ONLINE <BF00>
  2154  ERROR? >>218B
  2156  GET VOL NAME LENGTH  (0281)
  215B  NONE THERE? >>218B
  215F  ADD ONE TO NAME LENGTH (0280)
  2164  AND PREFIX IT WITH A "/" (0281)
  2167  ML1: SET PREFIX <BF00>
  216D  ERROR? >>218B

        ******** FIND STARTUP FILE **************

  216F  MLI: GET_FILE_INFO <BF00>
  2172  FIND "STARTUP" FILE
  2175  ERROR? >>218B
  217A  SAVE LENGTH OF STARTUP FILE NAME (2236)
  217D  COPY NAME TO $200 (2006)
  2186  FIRST COMMAND WILL BE "-STARTUP"
  218B  CHECK NUMBER OF SUBLEVELS (223E)
  2190  MORE THAN JUST VOL? >>2198
  2192  MLI: SET PREFIX <BF00>
  2198  ANY STARTUP FILE NAME? (2236)
  219B  YES, SKIP MESSAGE >>21C1
  219D  SET TRUE KSWL <2209>
  21A2  PRINT '         PRODOS BASIC 1.1' (2267)
  21AD  PRINT '       COPYRIGHT ... (2283)
  21B6  SKIP THREE LINES

        ******** FINISH UP AND GO TO B1 *********

  21C1  ---
  21C3  COPY WARMSTART JMP TO PAGE 3 (21FF)
  21C9  AND COLDSTART (03D3)
  21CC  AND CTL-Y (03F8)
  21CF  POINT & VECTOR (2206)
  21D2  TO $BE03 (CMD SCANNER) (03F5)
  21D8  COPY BRK HANDLER JMP ALSO (2202)
  21E7  AND RESET JMP (03F2)
  21F2  SET POWER-UP BYTE ACCORDINGLY (03F4)
```

```
BI Relocator -- V1.I -- I8 JUN 84                NEXT OBJECT ADDR: 21F7
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  21F7  SET APPLESOFT IN NON-TRACE MODE
  21F9  GET INTERPRETER VERSION NUMBER, (BC7A)
  21FC  PUT IT, IN SYSTEM GLOBAL PAGE. (BFFD)
  21FF  GO TO INTERPRETER >>BE00

        ******** VECTOR ADDRESSES ***************

  2202  BREAK HANDLER ADDRESS FOR PAGE 3
  2204  RESET HANDLER IS BASIC INTERP
  2206  APPLESOFT & GOES TO BI CMD SCANNER >>BE03

2209 *********** FIRST KSWL INTERCEPT *********************************

  2209  SET KSWL TO CURRENT DEVICE HANDLER (BE20)
  22I3  RETURN LENGTH OF FIRST COMMAND (2006)
  2217  FOLLOWED BY A RETURN
  2219  RETURN

22IA *********** DATA ************************************************

  221A  CSWL (20D4) INTERCEPT ADDR
  221C  KSWL (2209) INTERCEPT ADDR

  221E  GET FILE INFO PARMLIST
  22IF  FILE NAME IS AT $2006
  2221  I5 BYTES RESERVED FOR OTHER GET_FILE PARMS (NOT USED)
  2230  THIS BYTE NOT USED

  223I  SET PREFIX PARM LIST
  2232  FOR PREFIX AT $2234

  2234  NULL PREFIX
  2235  "/"

  2236  SAVED LENGTH OF STARTUP FILE NAME

  2237  ONLINE PARM LIST
  2239  PUT VOLUME NAME AT $281

  223B  SET PREFIX PARMLIST
  223C  PREFIX IS AT $280

  223E  NUMBER OF SUBLEVELS IN PREFIX +I

  223F  '***  UNABLE TO EXECUTE BASIC SYSTEM  ***'
  2267  '            PRODOS BASIC 1.1'
  2283  '        COPYRIGHT APPLE, 1983-84'
```

```
BI Relocator -- VI.I -- 18 JUN 84                NEXT OBJECT ADDR: 2283
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

22A3 *********** $22A3-$23FF NOT USED *********************************

  22A3  NOT USED

2400 *********** START OF BI IMAGE ************************************

2400    BASIC INTERP IMAGE
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9A00
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

9A00    MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  PRODOS BASIC INTERPRETER (BI)       *
          *       THIS CODE STARTS IN THE THIRD  *
          *       BLOCK OF THE FILE BASIC.SYSTEM.*
          *       IT PERFORMS COMMAND HANDLING   *
          *       FOR ALL BUILT-IN PRODOS COM-   *
          *       MANDS AND SUPPORTS BASIC'S FILE*
          *       HANDLING.                      *
          *                                      *
          *  VERSION 1.I -- 18 JUN 84            *
          *                                      *
          *  DISTRIBUTED WITH PRODOS VERSIONS    *
          *    I.1.1, 1.2, AND 1.3.              *
          *                                      *
          ****************************************

          ******** ZERO PAGE ADDRESSES ************

0024    CURSOR HORIZONTAL
0028    SCREEN LINE BASE ADDR
0029
0033    MONITOR PROMPT CHARACTER
0036    CRT DISPLAY VECTOR (CSWL)
0037
0038    KEYBOARD INPUT VECTOR (KSWL)
0039
003A    SCRATCH POINTER AND LOOP COUNTER
003B
003C    SCRATCH POINTER AND LOOP COUNTER
003D
003E    POINTER TO APPLESOFT VARIABLES
003F
0050    APPLESOFT: LINE NUMBER
005I
0067    APPLESOFT: START OF PROGRAM PTR
0068
0069    APPLESOFT: LOMEM (START OF VARS)
006A
006B    APPLESOFT: START OF ARRAY VARS PTR
006C
006E    APPLESOFT: START OF FREEAREA PTR
006D
006F    APPLESOFT: START OF STRINGS PTR
0070
0073    APPLESOFT: HIMEM (END OF STRINGS)
0074
0075    APPLESOFT: CURRENT LINE BEING EXECUTED
0076
```

```
BASIC Interpreter (BI) -- V1.I --18 JUN 84      NEXT OBJECT ADDR: 9A00
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

009B    APPLESOFT: ADDR OF LINE AFTER FINDLINE
009C
00AF    APPLESOFT: END OF PROGRAM PTR
00B0
00B8    APPLESOFT: START OF PROGRAM PTR
00B9
00D6    APPLESOFT: PROGRAM LOCKED (PROTECTED)
00D8    APPLESOFT: ONERR ACTIVE FLAG
00DE    APPLESOFT: ONERR CODE
00F2    APPLESOFT: TRACE ACTIVE FLAG
00F8    APPLESOFT: INTERNAL STACK

          ******** EXTERNAL ADDRESSES *************

0100    START OF 6502 STACK
0200    KEYBOARD INPUT LINE BUFFER
03F4    POWERON RESET FLAG

          ******** BI GLOBAL PAGE *****************

BE06    EXTERNAL COMMAND ENTRY TO BI
BE0C    PRINT ERROR MESSAGE ENTRY TO BI
BE0F    PRODOS ERROR CODE
BE10    OUTPUT VECTORS FOR ALL SLOTS
BE30    CURRENT OUTPUT VECTOR
BE32    CURRENT INPUT VECTOR
BE34    PRODOS INTERCEPT VECTORS (INPUT/OUTPUT)
BE38    BI'S INTERNAL REDIRECTION VECTORS
BE3C    DEFAULT SLOT
BE3D    DEFAULT DRIVE
BE3E    A REGISTER SAVE AREA
BE3F    X REGISTER SAVE AREA
BE40    Y REGISTER SAVE AREA
BE4I    TRACE FLAG (APPLESOFT TRACE ON/OFF)
BE42    IMMEDIATE COMMANDS=0, DEFERRED=1
BE43    EXEC FILE ACTIVE=$80
BE44    READ FILE ACTIVE=$80
BE45    WRITE FILE ACTIVE=$80
BE46    READING PREFIX ACTIVE=$80
BE47    DIRECTORY FILE BEING ACCESSED
BE49    FREE STRING SPACE DURING GARBAGE COLLECT
BE4A    BUFFERED I/O BYTE COUNT
BE4B    INDEX INTO INPUT COMMAND LINE
BE4C    LAST OUTPUT CHAR TO PREVENT RECURSION
BE4D    NUMBER OF OPEN NON-EXEC FILES
BE4E    EXEC FILE BEING CLOSED FLAG
BE4F    READ FILE IS TRANSLATED DIRECTORY
BE50    VECTOR TO EXTERNAL COMMAND HANDLER
BE52    LENGTH-I OF EXTERNAL COMMAND STRING
BE53    COMMAND NUMBER
BE54    PARAMETERS ALLOWED FOR THIS COMMAND
```

```
BASIC Interpreter (BI) -- VI.I --I8 JUN 84      NEXT OBJECT ADDR: 9AØØ
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

          (SEE BIT DEFINITIONS IN TABLE LATER)
BE56    PARAMETERS FOUND WITH THIS COMMAND
          (SAME BIT DEFINITIONS AS FOR PBITS)
BE58    A KEYWORD VALUE
BE5A    B KEYWORD VALUE
BE5D    E KEYWORD VALUE
BE5F    L KEYWORD VALUE
BE6I    S KEYWORD VALUE
BE62    D KEYWORD VALUE
BE63    F KEYWORD VALUE
BE65    R KEYWORD VALUE
BE68    @ KEYWORD VALUE
BE6A    T KEYWORD VALUE
BE6B    SLOT NUMBER FROM IN# OR PR#
BE7Ø    ISSUE MLI CALL AND XLATE ERROR CODES
          MLI PARM LIST FIELDS
BEA3    CREATE: ACCESS CODE
BEA4    CREATE: FILE ID
BEA5    CREATE: AUX ID
BEA7    CREATE: FILE KIND
BEB4    SET/GET FILE INFO: PARM COUNT
BEB7    SET/GET FILE INFO: ACCESS CODE
BEB8    SET/GET FILE INFO: FILE ID
BEB9    SET/GET FILE INFO: AUX ID
BEBB    SET/GET FILE INFO: FILE KIND
BEBC    SET/GET FILE INFO: BLOCKS USED
BEBE    SET/GET FILE INFO: MODIFY DATE/TIME
BEC7    ONLINE/GET/SET MARK/EOF/BUF: REF NUM
BEC8    ONLINE/GET/SET MARK/EOF/BUF: MARK/BUF
BECE    OPEN: SYSTEM BUFFER
BED0    OPEN: REF NUM RETURNED
BED2    NEWLINE: REF NUM
BED3    NEWLINE: NEW LINE CHAR (ALWAYS CR)
BED6    READ/WRITE: REF NUM
BED7    READ/WRITE: DATA ADDRESS
BED9    READ/WRITE: LENGTH OF DATA
BEDB    READ/WRITE: ACTUAL LENGTH TRANSMITTED
BEDE    CLOSE/FLUSH: REF NUM
BEFB    BASIC HIMEM VALUE

          ******** SYSTEM GLOBAL PAGE *************

BF03    QUIT VECTOR
BF30    LAST DEVICE USED
BF58    MEMORY UTILIZATION BIT MAP
BF94    OPEN FILE LEVEL
BF9A    PREFIX ACTIVE FLAG (IF NONZERO)
```

```
BASIC Interpreter (BI) -- VI.I --I8 JUN 84      NEXT OBJECT ADDR: 9AØØ
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

          ******** INPUT/OUTPUT LOCATIONS *********

C000    KEYBOARD STROBE
C010    KEYBOARD STROBE CLEAR
CFFF    RESET I/O ROMS

          ******** APPLESOFT ROM LOCATIONS ********

D43F    APPLESOFT RESTART ENTRY
D61A    FIND LINE BY NUMBER IN APPLESOFT
D665    SET POINTERS IN APPLESOFT
D7D2    EXECUTE NEW APPLESOFT STATEMENT
D820    APPLESOFT CMD EXECUTE
D865    APPLESOFT SIGNAL ERROR
ED24    APPLESOFT PRINT DECIMAL NUMBER
F273    APPLESOFT SET NORMAL CHARS

          ******** MONITOR ROM LOCATIONS **********

FC58    MONITOR CLEAR SCREEN/HOME CURSOR
FC9C    MONITOR CLEAR TO EOL
FD10    MONITOR READ KEY (NO CURSOR)
FDED    COUT VECTOR

9AØØ ********** BASIC INTERPRETER LOAD POINT ************************
          (ENTRY POINT IS AT $ABF1, WARMDOS)

9AØØ ********** REMOVE KSWL/CSWL INTERCEPTS *************************

  9AØØ  ---
  9A01  REPLACE CSWL/KSWL WITH CURRENT (BE30)
  9A04  ACTUAL DEVICE DRIVER VECTORS
  9A16  RETURN

9AI7 ********** RESET MODE/SET BI INTERCEPTS ************************

  9AI7  SET IMMEDIATE COMMAND MODE
  9A19  AND GO SET I/O VECTORS <9F76>
  9A1C  KSWL/H ALREADY SET?
  9A21  NO? THEN CHECK CSWL >>9A26
  9A23  YES, CONTINUE >>9AA3
  9A26  CSWL/H ALREADY SET?
  9A2B  YES, CONTINUE >>9AA3
  9A2D  NO, SAVE CURRENT INTERCEPTS FIRST >>9A8D
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9AA2
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

9AA3 *********** SET CSWL/KSWL INTERCEPTS ****************************

  9AA3  ---
  9AA4  COPY VDOSIO VECTORS (BE34)
  9AA7  TO CSWL
  9AB1  AND KSWL
  9AB9  EXIT TO CALLER

9ABA *********** INPUT INTERCEPT: MODE = Ø ***************************
         (IMMEDIATE MODE)

  9ABA  IS EXEC FILE ACTIVE? (BE43)
  9ABD  NO >>9AC5
  9ABF  YES, SAVE REGISTERS <9F62>
  9AC2  AND GO READ EXEC FILE FOR INPUT COMMANDS >>9BAF

  9AC5  NO EXEC FILE, RESTORE REAL CSWL/KSWL  <9AØØ>
  9AC8  NO, READ A KEY FROM KEYBOARD <FD1Ø>
  9ACB  RETURN?
  9ACD  NO, EXIT >>9AEB
  9ACF  YES, SAVE REGISTERS <9F62>
  9AD2  STORE IT IN LINE BUFFER (Ø2ØØ)
          --> THIS ENTRY CALLED BY EXEC TO PROCESS
              A COMMAND STRING STORED AT $2ØØ
  9AD5  GO PROCESS THE COMMAND STRING <A677>
  9AD8  CHECK COMMAND NUMBER RETURNED FROM PARSE (BE53)
  9ADB  EXIT BI RIGHT NOW? >>9AE8
  9ADD  NO, COMMAND RETURNED WITH ERROR CODE? >>9AFØ
  9ADF  NO, RESTORE Y REG (BE4Ø)
  9AE2  RETURN A BACKSPACE TO CALLER OF KEYBOARD
  9AE4  AND A LINE INDEX OF ZERO
  9AE6  EXIT THE BI >>9AEB

  9AE8  RESTORE CALLER'S REGISTERS <9F6C>
  9AEB  AND EXIT BI BY INSTALLING INTERCEPTS >>9A8D

9AEE *********** ERROR HANDLER ***************************************

  9AEE  ERROR=3, "NO DEVICE CONNECTED"
  9AFØ  MAIN ENTRY: STORE ERROR CODE (BEØF)
  9AF3  AND IN APPLESOFT ONERR
  9AF5  CHECK BI STATE (BE42)
  9AF8  MEMORIZE WHETHER IT'S IMMEDIATE MODE
  9AFD  SET A HIGH FILE LEVEL FOR NON-EXEC FILES (BF94)
  9BØ2  NO ACTIVE READ/WRITE FILES OR PREFIX READ (BE44)
  9BØB  CLOSE ALL OPEN FILES AT OR ABOVE (BEDE)
  9BØE  FILE LEVEL = $ØF
  9B1Ø  MLI: CLOSE (ALL) <BE7Ø>
  9B13  ERROR? >>9B27
  9B15  WRITE ANY DATA I HAVE BUFFERED <AØØØ>
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9A2F
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

9A2F *********** OUTPUT INTERCEPT: MODE = Ø ***************************
         (IMMEDIATE MODE)

  9A2F  "#" CHARACTER? (9F61)
  9A32  NO... >>9A54
  9A34  ELSE, SAVE X REG (BE3F)
  9A38  CHECK STACK FOR $D812 AS RETURN ADDR (Ø1Ø3)
  9A3B  (APPLESOFT TRACE, PRINTING #LINENO)
  9A44  NOT TRACING? >>9A6E
  9A46  ELSE, SET DEFERED MODE=4
  9A4B  GET SET TO PRINT THE "#" (9F61)
  9A4E  RESTORE X REG (BE3F)
  9A51  AND GO TO OTHER OUTPUT HANDLER >>B7F1

  9A54  NOT A #, SAME AS LAST OUTPUT THO? (BE4C)
  9A57  (SAVE FOR NEXT TIME THRU) (BE4C)
  9A5A  NO, ALL IS WELL >>9A74
  9A5C  TWO RETURNS IN A ROW?
  9A5E  NO, ALL IS WELL  >>9A74
  9A6Ø  HAS HORIZONTAL CURSOR POSN CHANGED?
  9A62  YES... >>9A69
  9A64  ELSE, ANYTHING IN PATHNAME BUFFER? (BCBD)
  9A67  (MUST BE ALPHA)
  9A69  RESTORE A REG
  9A6B  PATHNAME IS THERE... >>9A74
  9A6D  ELSE, WE ARE RECURSING INFINITELY, EXIT!
  9A6E  WE WERE'NT TRACING AFTER ALL, RESTORE X (BE3F)
  9A71  AND A REGS, THEN FALL THRU TO EXIT (9F61)

9A74 *********** ECHO OUTPUT CHAR AND EXIT ***************************

  9A74  PUT BACK REAL CSWL/KSWL VECTORS <9AØØ>
  9A77  OUTPUT THE CHARACTER <FDED>
  9A7A  WAS IT A RETURN?
  9A7C  NO, EXIT NOW >>9A8D
  9A7E  ELSE, WAS APPLESOFT TRACING?
  9A82  YES >>9A8B
  9A84  NO, CLEAR MY TRACE FLAG (PSEUDO TRACE NOW) (BE41)
  9A87  FORCE APPLESOFT TO TRACE FOR MY BENEFIT ONLY
  9A8B  RESTORE A REG AND FALL THRU TO EXIT BI

9A8D *********** SAVE ACTUAL IN/OUT VECTORS ***************************

  9A8D  ---
  9A8E  COPY KSWL/H TO VECIN
  9A98  AND CSWL/H TO VECOUT
  9A9A  IN BI GLOBAL PAGE (BE31)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9B18
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  9B18  ERROR? >>9B27
  9B1A  PUT FILE LEVEL BACK TO ZERO
  9B22  NOW FLUSH ALL OPEN FILES
  9B24  MLI: FLUSH (ALL) <BE70>
  9B27  ---
  9B28  ASSUME MODE WILL BE 4 (DEFERRED)
  9B2A  MEMORIZE WHETHER BASIC ONERR ACTIVE
  9B2C  DEFERRED MODE CURRENTLY? >>9B30
  9B2E  NO, STILL IMMEDIATE MODE (MODE=0)
  9B30  ---
  9B31  SET MODE AS DEFINED ABOVE <9F76>
  9B34  RESTORE BI'S CSWL/KSWL INTERCEPTS <9AA3>
  9B37  GET ERROR CODE (BE0F)
  9B3B  BASIC ONERR ACTIVE? THEN GO HANDLE IT >>9B4D
  9B3E  NO, JUST PRINT ERROR MESSAGE <BE0C>
  9B41  CLOSE EXEC FILE IF ONE IS OPEN <B2FB>
  9B45  DEFERRED MODE?  >>9B53
  9B47  IMMED. MODE, PRINT RETURN AND... <9FAB>
  9B4A  WARMSTART APPLESOFT >>D43F

  9B4D  RESTORE STACK FOR BASIC
  9B52  PASS ERROR CODE TO BASIC
  9B53  ---
  9B55  JUMP INTO APPLESOFT ERROR HANDLER >>D865

9B58 *********** RETURN TO IMMED. MODE ********************************

  9B58  CLEAR APPLESOFT ERRNUM
  9B5C  WILL LOOK FOR "#" FROM APPLESOFT
  9B61  SET NORMAL VIDEO IN APPLESOFT <F273>
  9B64  RESTORE TRUE CSWL/KSWL <9A00>
  9B67  TRY TO WRITE BUFFERED DATA <9FF4>
  9B6A  RESET MODE/SET UP BI'S INTERCEPTS <9A17>
  9B6D  RESTORE REGISTERS <9F6C>
  9B70  GO TO PROCESS IMMED. INPUT REQUEST >>9ABA

9B73 *********** INPUT INTERCEPT: MODE=4 OR 8 ************************

  9B73  SAVE REGISTERS <9F62>
  9B76  PREFIX INPUT ACTIVE? (BE46)
  9B79  NO >>9B7E
  9B7B  YES, GO DO SPECIAL HANDLING >>9D67
  9B7E  ELSE, IS READ FILE ACTIVE? (BE44)
  9B81  NO >>9B86
  9B83  YES, GO DO SPECIAL HANDLING FOR THAT >>9C16
  9B86  ELSE, IS EXEC FILE ACTIVE? (BE43)
  9B89  NO >>9BAF
  9B8B  YES, GET PROMPT CHARACTER
  9B8D  IT BETTER NOT BE A "]"
  9B8F  IT IS, RETURN TO IMMEDIATE MODE >>9B58
  9B91  ELSE, SET TRUE CSWL/KSWL <9A00>
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9B94
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  9B94  AND PASS CALLER'S AREG TO REMOVE CURSOR (BE3E)
  9B97  RESTORE Y-REGISTER (BE40)
  9B9A  REMOVE CURSOR AND GET A KEYPRESS <FD10>
  9B9D  BACKSPACE?
  9B9F  NO, EXIT BI >>9BAC
  9BA1  YES, CHECK PROMPT
  9BA3  IF ITS A ">"...
  9BA5  THEN EXIT WITH THE BACKSPACE >>9BAA
  9BA8  ELSE, IF AT START OF LINE, REPROMPT >>9B94
  9BAA  MIDDLE OF LINE, RETURN A BACKSPACE
  9BAC  EXIT BI TO CALLER >>9A8D

9BAF *********** READ EXEC FILE ***********************************

  9BAF  REMOVE CURSOR FROM SCREEN
  9BB1  CHECK PROMPT CHARACTER
  9BB3  IF ITS A ">"...
  9BB5  DO THINGS DIFFERENTLY >>9BF2
  9BB7  CHECK KEYBOARD (C000)
  9BBA  NO KEY READY?  >>9BCD
  9BBC  GOT A KEY, IS IT CONTROL-C?
  9BBE  NO, IGNORE IT >>9BCD
  9BC0  YES, CLOSE EXEC FILE <B2FB>
  9BC3  IMMEDIATE MODE? (BE42)
  9BC6  NO >>9C01
  9BC8  YES, CLEAR KEYBOARD STROBE (C010)
  9BCB  AND GO START NEW LINE >>9C01
  9BCD  SET UP FOR EXEC LINE READ <9D8A>
  9BD0  READ A LINE TO $200 <9C6C>
  9BD3  ERROR? >>9BFA
  9BD5  SAVE REGISTERS <9F62>
  9BD8  HOP INTO LOOP >>9BDE
  9BDA  ---
  9BDB  BACKSCANNING $200 BUFFER (0200)
  9BDE  FORCING THE MSB ON
  9BE6  RESTORE TRUE CSWL/KSWL <9A00>
  9BE9  GO PROCESS COMMAND LINE <9AD5>
  9BEC  CHECK COMMAND NUMBER (BE53)
  9BEF  IMMEDIATE EXIT? IF NOT, GET NEXT LINE >>9BCD
  9BF1  RETURN

        ******** HANDLE EXEC PROMPT > ***********

  9BF2  GET SET TO READ EXEC LINE <9D8A>
  9BF5  READ SINGLE CHARACTER PER CALL <9C48>
  9BF8  NO ERRORS, EXIT TO CALLER NOW >>9BF1
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9BF8
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

        ******** EXEC ERROR RECOVERY ************

  9BFA  CLOSE EXEC FILE <B245>
  9BFD  WAS ERROR "END OF DATA"?
  9BFF  NO, REAL ERROR THEN >>9C13
  9C01  ELSE, OK -- JUST STOP EXECING
  9C03  GET CURSOR HORIZONTAL POSITION
  9C05  IF IN MID LINE, PASS SCREEN CHAR BACK >>9C0E
  9C07  ELSE, CHANGE PROMPT TO "]"
  9C0B  AND RETURN WITH A BACKSPACE
  9C0D  RETURN
  9C0E  GET SCREEN CHARACTER UNDER CURSOR
  9C10  AND EXIT THRU KSWL TO GET REAL KEYPRESS >>0038
  9C13  REAL ERROR, GO TO BI'S MAIN ERROR HANDLER >>9AF0

9C16 *********** INPUT FILE ACTIVE **********************************

  9C16  GET PROMPT
  9C18  IF ITS A "]"...
  9C1C  THEN RESET TO IMMEDIATE MODE >>9B58
  9C1F  ELSE, REMOVE CURSOR FROM SCREEN (BE3E)
  9C24  CHECK KEYBOARD (C000)
  9C27  NO KEYPRESS? >>9C31
  9C29  GOT A KEY, IS IT CONTROL-C?
  9C2B  NO, IGNORE IT >>9C31
  9C2D  CLEAR STROBE AND EXIT TO CALLER (C010)
  9C30  RETURN

  9C31  GET PROMPT AGAIN
  9C33  IS THIS A DIRECTORY FILE? (BE47)
  9C36  YES >>9C95
  9C38  NO, IS PROMPT = ">"?
  9C3A  YES, READ A SINGLE BYTE AT A TIME >>9C42
  9C3C  ELSE, READ ENTIRE LINE <9C67>
  9C3F  ERROR? >>9C13
  9C41  RETURN

  9C42  READ SINGLE BYTE FROM INPUT FILE <9C48>
  9C45  ERROR? >>9C13
  9C47  RETURN

9C48 *********** READ NEXT BYTE OF FILE ******************************

  9C48  SAVE CURRENT READ/WRITE COUNT (BED9)
  9C4B  IN L KEYWORD VALUE (BE5F)
  9C50  SET UP TO READ ONE BYTE (BED9)
  9C55  MLI: READ <BE70>
  9C58  ERROR? >>9C66
  9C5A  PUT COUNT BACK TO MAXIMUM AGAIN (BE5F)
  9C60  GET FIRST CHARACTER ON $200 LINE (BED7)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9C63
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  9C63  AND RETURN THAT TO CALLER (0200)
  9C66  RETURN

9C67 *********** READ NEXT LINE OF FILE ******************************

  9C67  REMOVE CURSOR FROM SCREEN (BE3E)
  9C6C  ---
  9C6E  MLI: READ <BE70>
  9C71  ERROR? >>9C66
  9C73  GET LENGTH ACTUALLY TRANSMITTED (BEDB)
  9C76  NOTHING? >>9C8E
  9C79  GOT SOMETHING, FIND END OF DATA (BED7)
  9C7D  FETCH LAST BYTE OF LINE (01FF)
  9C82  IS IT A RETURN CHARACTER?
  9C84  NO, LEAVE LINE ALONE >>9C8E
  9C86  YES, WAS L KEYWORD GIVEN? (BE57)
  9C8B  YES, LEAVE IT BE >>9C8E
  9C8D  ELSE, CHOP OFF THE RETURN ITSELF
  9C8E  AND EXIT WITH A RETURN
  9C90  RESTORING Y REG AS YOU GO (BE40)
  9C94  RETURN

9C95 *********** READING DIR FILE ************************************

  9C95  ">" PROMPT?
  9C97  YES, EXIT RIGHT NOW >>9C8E
  9C99  ELSE, REMOVE CURSOR FROM SCREEN (BE3E)
  9C9E  SET 80 COLUMNS
  9CA5  MLI: GET MARK <BE70>
  9CA8  ERROR? >>9D1F
  9CAA  ARE WE AT BEGINNING OF THIS FILE? (BEC8)
  9CB0  NO, CONTINUE >>9CDF
  9CB2  YES, CAT FLAG = 2
  9CB7  READ DIRECTORY HEADER <BI5D>
  9CBA  ERROR? >>9D1F
  9CBC  REF NUM TIMES 32 (BED6)
  9CC7  SET THE L VALUE OF THIS DIR FILE IN (BCFF)
  9CCA  THE OPEN FILE LIST TO THE ENTRY LENGTH (BCB8)
  9CCD  AND THE NUMBER OF ENTRIES PER BLOCK (BD00)

        ******** FORMAT DIRECTORY NAME **********

  9CD0  GO FORMAT NAME OF DIRECTORY <B0B8>
  9CD3  STORE THE LENGTH OF LINE AT $200
  9CD8  PUT A RETURN CHAR AT END OF LINE
  9CDD  AND EXIT TO CALLER
  9CDE  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9CDE
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

 9CDF  GET CAT FLAG (BE4F)
 9CE2  IF ZERO, GO PROCESS INDIVIDUAL ENTRIES >>9D22
 9CE4  IF MINUS, GO DO SUMMARY LINE OR EXIT >>9CF9
 9CE6  POSITIVE, ASSUME NULL LINE WANTED
 9CE8  DROP CAT FLAG BY ONE (BE4F)
 9CEB  IF ZERO, JUST GO PRINT A BLANK LINE >>9CD3

       ******** FORMAT TITLE LINE **************

 9CED  ELSE, BLANK OUT $200 AND <A66C>
 9CF2  UNPACK "NAME TYPE BLOCKS ETC... <9FB0>

 9CF5  LINE LENGTH IS 80
 9CF7  GO RETURN IT TO CALLER >>9CD3

       ******** FORMAT SUMMARY LINE *************

 9CF9  DO SUMMARY LINE?
 9CFB  NO, JUST EXIT (ALL DONE) >>9DIC
 9CFD  YES, DROP CAT FLAG SO EXIT NEXT TIME (BE4F)
 9D02  CLEAR READ/WRITE COUNT (BED9)
 9D0A  MLI: READ <BE70>
 9D0D  FORMAT BLOCKS FREE AND INUSE SUMMARY LINE  <B0E7>
 9D11  GET REF NUM (BED6)
 9D14  AND COPY TO GET/SET LIST (BEC7)
 9D18  NO ERRORS, EXIT >>9CF5
 9D1A  ERROR, JUMP TO BI ERROR EXIT >>9D1F
 9DIC  "END OF DATA" ERROR
 9D1F  GO TO BI ERROR EXIT >>9AF0

       ******** FORMAT FILE/DIR ENTRIES ********

 9D22  SET DIR ENTRY NUM COUNTER TO -1
 9D27  GET REF NUM (BED6)
 9D2A  *32
 9D2F  USE AS INDEX TO GET ENTRY LENGTH (BCFF)
 9D35  AND ENTRIES PER BLOCK FROM OPEN FILE LIST (BD00)
 9D3B  POSITION ON EVEN BLOCK BOUNDARY (BEC9)
 9D41  AND GET SECTOR OFFSET (BEC8)
 9D45  SKIP FILE/DIR ENTRIES UNTIL POSITIONED TO (BCBB)
 9D48  CURRENT POSITION IN THIS BLOCK (BCB7)
 9D50  READ NEXT DIR ENTRY FROM FILE <BID1>
 9D53  NO ERROR? >>9D61
 9D55  ERROR, IF RANGE ERROR...
 9D57  NO, TRUE ERROR >>9D1F
 9D59  RANGE ERROR, READY FOR SUMMARY LINE NEXT (BE4F)
 9D5E  RETURN A BLANK LINE THIS TIME >>9CD3
```

```
BASIC Interpreter (BI) -- V1.1 --I8 JUN 84      NEXT OBJECT ADDR: 9D5E
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

 9D6I  FORMAT FILE/DIR ENTRY INTO $201 <A4C4>
 9D64  AND RETURN IT TO CALLER >>9CF5

9D67 *********** PREFIX INPUT ACTIVE *********************************

 9D67  PROMPT = "]"?
 9D69  NO, ALL IS WELL >>9D6E
 9D6B  YES, RETURN TO IMMEDIATE MODE NOW >>9B58
 9D6E  REMOVE CURSOR FROM SCREEN (BE3E)
 9D75  PREFIX NO LONGER ACTIVE AFTER THIS (BE46)
 9D7B  COPY PATHNAME BUFFER (PREFIX) (BCBC)
 9D7E  TO $200 (01FF)
 9D84  RETURN WITH IT TO BASIC  (BCBC)
 9D89  RETURN

9D8A *********** SETUP TO READ LINE FROM EXEC ************************

 9D8A  SET READ REF NUM FOR EXEC FILE (BCA3)
 9D90  READ TO $200
 9D95  FOR $EF BYTES OF LENGTH
 9D9A  (OR UNTIL A RETURN CHAR)
 9DA2  RETURN

9DA3 *********** OUTPUT INTERCEPT: MODE = C ***************************
       (LOOK FOR CONTROL-D)

 9DA3  SAVE REGISTERS <9F62>
 9DA6  PRINTING A CONTROL-D?
 9DA8  NO >>9DC1
 9DAA  YES, WRITE OUT ANY BUFFERED DATA <9FF4>
 9DAD  NOTHING IN COMMAND LINE (BE4B)
 9DB0  READ FILE INACTIVE (BE44)
 9DB3  WRITE FILE INACTIVE (BE45)
 9DB6  PREFIX READ INACTIVE (BE46)
 9DBB  SET MODE = B FROM NOW ON <9F76>
 9DBE  RESTORE REGS AND EXIT >>9F6C

 9DC1  GOT A CONTROL-D...
 9DC3  SET MODE = 4 FROM NOW ON <9F76>
 9DC6  RESTORE REGISTERS <9F6C>
 9DC9  OUTPUT CHARACTER AND EXIT >>B7F1

9DCC *********** OUTPUT INTERCEPT: MODE = 8 ***************************
       (ASSEMBLE COMMAND LINE)

 9DCC  SAVE REGISTERS <9F62>
 9DD2  SAVE CHAR IN COMMAND LINE (0200)
 9DD5  WAS IT A RETURN?
 9DD7  YES, READY TO ROLL >>9DE7
 9DD9  NO, BUMP CHARACTER COUNTER (BE4B)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9DDC
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  9DDC  AND EXIT TO CALLER >>9DE3
  9DDE  OOPS! LINE TOO LONG
  9DE0  "SYNTAX ERROR" >>9AF0
  9DE3  ELSE, RESTORE X REG AND EXIT (BE3F)
  9DE6  RETURN

  9DE7  ---
  9DE9  NULL LINE? >>9DF6
  9DEB  NO, PUT BACK TRUE CSWL/KSWL <9A00>
  9DEE  SYNTAX SCAN CMD LINE <A677>
  9DF1  ERROR? >>9DE0
  9DF3  NO, PUT BACK BI'S INTERCEPTS <9A8D>
  9DF6  ---
  9DF8  MODE = 4 NOW  <9F76>
  9DFB  RESTORE REGS AND EXIT >>9F6C

9DFE ********** WRITE BUFFERED CHARACTER ***************************

  9DFE  SAVE Y REG (BE40)
  9E01  CHECK PROMPT
  9E03  CHECK TO SEE IF WE ARE IN "IF", >>9E11
  9E06  "PRINT", "LIST", OR "CALL" STATEMENTS >>9E11
  9E09  OF AN APPLESOFT PROGRAM >>9E11
  9E0B  IF NOT, EXIT TO CALLER... (BE40)
  9E0E  WITH CHARACTER ECHOED TO SCREEN >>9A74

  9E11  GET INDEX TO TEMPORARILY BUFFERED CHARS (BE4A)
  9E16  STORE INTO BUFFER JUST ABOVE HIMEM
  9E1B  BUMP INDEX (BE4A)
  9E1E  OK >>9E2B
  9E20  BUFFER FULL, SAVE REGISTERS <9F62>
  9E23  WRITE BUFFER OUT TO DISK <9FEE>
  9E26  ERROR? >>9DE0
  9E28  RESTORE REGISTERS <9F6C>
  9E2B  AND EXIT ANYWAY

9E2C ********** OUTPUT INTERCEPT: MODE = 4 **************************
          (INITIAL ENTRY FOR A RUNNING PROGRAM)
          (FLUSH OUT NON COMMAND LINES)

  9E2C  PRINTING A "#"? (9F61)
  9E2F  NO >>9E49
  9E31  YES, SAVE X REGISTER (BE3F)
  9E35  RETURN ADDR IS IN APPLESOFT... (0103)
  9E38  TRACE ROUTINE...
  9E3C  AT $D812? (0104)
  9E41  YES >>9EB6
  9E43  NO, RESTORE REGISTERS (9F61)
  9E49  IS WRITE FILE ACTIVE? (BE45)
  9E4C  NOPE >>9E6C
  9E4E  YES, PRINTING A "]"?
```

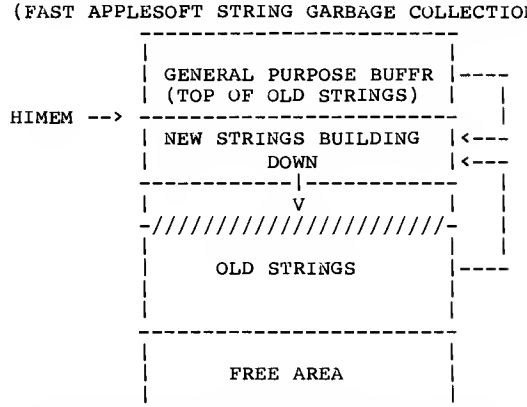
```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9E50
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  9E50  NO >>9E56
  9E52  YES, SAME AS PROMPT CHARACTER?
  9E54  YES >>9E86
  9E56  NO, PRINTING A RETURN CHAR?
  9E58  NO >>9DFE
  9E5A  YES, GET PROMPT
  9E60  DOES IT INDICATE RECURSION? >>9DFE
  9E62  YES, WRITE BUFFER OUT <9FF4>
  9E65  OUTPUT FILE INACTIVE NOW (BE45)
  9E6A  EXIT WITH RETURN CHAR >>9E9F

  9E6C  ---
  9E6D  INPUT FILE ACTIVE? (BE44)
  9E73  NO >>9E7D
  9E75  YES, CHECK PROMPT
  9E77  OR IN $04
  9E79  CONTROL-D?
  9E7B  YES >>9EA2
  9E7D  ---
  9E7E  NO, HOW BOUT "]"?
  9E80  NO, EXIT WITH ECHO THEN >>9E9F
  9E82  YES, IS THIS THE PROMPT CHAR?
  9E84  NO, EXIT WITH ECHO >>9E9F
  9E86  YES, SAVE REGISTERS <9F62>
  9E89  CHECK OPEN FILE COUNT (BE4D)
  9E8C  NONE OPEN? >>9E9C
  9E8E  SOME OPEN, WRITE BUFFER OUT <9FF4>
  9E91  INDICATE WRITE FILE INACTIVE NOW (BE45)
  9E94  SET TRUE CSWL/KSWL <9A00>
  9E99  PRINT "FILE(S) STILL OPEN" <BE0C>
  9E9C  RESTORE REGS <9F6C>
  9E9F  AND ECHO EXIT >>9A74

  9EA2  ---
  9EA3  CHAR IS A RETURN?
  9EA5  NO >>9EAA
  9EA7  YES, SAME AS LAST CHAR OUTPUT? (BE4C)
  9EAA  (SAVE IT FOR THIS TEST NEXT TIME) (BE4C)
  9EAD  NOT SAME, NO PROBLEM THEN >>9EB1
  9EAF  SAME, MARK PROMPT FOR RECURSION
  9EB1  RETURN

9EB2 ********** APPLESOFT TRACE INTERCEPT **************************
          (CONTROL PASSES HERE FOR EVERY STATEMENT)
          (EXECUTED WHILE PRODOS IS ACTIVE)

  9EB2  BUMP APPLESOFT LINE POINTER
  9EB6  ---
  9EBA  MARK PROMPT FOR RECURSION
  9EBC  JUST IN CASE WE DIE IN HERE
  9EBE  RESTORE APPLESOFT'S STACK
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9EC1
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  9EC1  DOES BI KNOW WE ARE TRACING? (BE41)
  9EC4  YES, REAL LIVE TRACE THEN >>9F39

  9EC6  ELSE, PICK UP NEXT TOKEN ON LINE
  9ECA  IS IT A TOKEN? >>9EF1
  9ECC  OR END OF LINE? >>9EEE
  9ECE  NEITHER, DECREMENT STRING SPACE CTR (BE49)
  9ED1  OK >>9EEC
  9ED3  COMPUTE SIZE OF FREESPACE IN PAGES
  9ED7  AT LEAST 3 PAGES AVAILABLE?
  9ED9  YES >>9EE5
  9EDB  NO, WRITE BUFFERED DATA <9FF4>
  9EDE  AND THEN GARBAGE COLLECT <A044>
  9EE3  COMPUTE FREE SPACE NOW
  9EE5  AND SAVE IN STRING SPACE CTR (BE49)
  9EEA  GET NEXT TOKEN
  9EEC  ---
  9EEE  JUMP BACK INTO APPLESOFT TO EXECUTE IT >>D820
  9EF1  STORE TOKEN IN PROMPT
  9EF4  LOOK UP TOKEN IN BI'S TOKEN TABLE (B799)
  9EF7  ITS NOT ONE BI IS INTERESTED IN >>9EEE
  9EF9  IT IS INTERESTING, CHANGE BRANCH (9EFD)
  9EFC  AND JUMP TO ONE OF THE FOLLOWING: >>9EFE

  9EFE  IF OR PRINT: PROMPT = 0
  9F00  CLEAR OUT LAST CHAR SAVEAREA (BE4C)
  9F03  GO TO MODE = C NEXT TIME THRU (B803)
  9F06  (BEGIN LOOKING FOR COMMANDS) (BE38)
  9F0F  NOW GO PROCESS THE IF OR PRINT >>9F2E

  9F11  LIST: PROMPT = 1
  9F13  (DON'T LOOK FOR COMMANDS NOW)
  9F15  GO DO IT >>9F2E

  9F17  CALL: PROMPT = 2
  9F19  (DON'T LOOK FOR COMMANDS NOW)
  9F1B  GO DO IT >>9F2E

  9F1D  LET: DECREMENT STRING CTR
  9F1E  AND GO BACK FOR NEXT TOKEN >>9ECE

  9F21  TRACE: TURN TRACE ON (BE41)
  9F24  THEN CONTINUE BELOW >>9F2A

  9F26  NOTRACE: DROP INTO BACKGROUND TRACE (BE41)
  9F29  CHANGE TOKEN TO "TRACE"
  9F2A  FORCE ON APPLESOFT TRACE
  9F2E  ---
  9F2F  GO BACK TO APPLESOFT TO PERFORM IT >>D820
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9F2F
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  9F32  RESUME: CLEAR ONERR CODE
  9F37  GO TO APPLESOFT TO PROCESS IT >>9EEC

        ******** REAL TRACE ACTIVE **************

  9F39  RESTORE TRUE CSWL/KSWL <9A00>
  9F3E  PRINT "#" <FDED>
  9F45  USE APPLESOFT TO PRINT CURRENT LINE NO. <ED24>
  9F4A  PRINT A BLANK SPACE <FDED>
  9F4D  PUT BI'S CSWL/KSWL INTERCEPTS BACK <9A8D>
  9F51  THEN GO BACK AND HANDLE AS USUAL  >>9EC6

  9F54  LOOKING FOR A LOWER CASE "c"
  9F58  LOOKING FOR A "#"
  9F5A  STORE CHAR TO SEARCH FOR (9F61)
  9F5E  BRANCH BACK INTO APPLESOFT >>9EEC
  9F60  BREAK IF Y IS ZERO!!!

  9F61  "#" CHARACTER (ASOFT TRACE CHAR)

9F62 ********** SAVE CALLER'S REGISTERS ****************************

  9F62  SAVE A,X AND Y REGS (BE3E)
  9F6B  RETURN

9F6C ********** RESTORE CALLERS REGISTERS **************************

  9F6C  RESTORE A,X AND Y REGS (BE3E)
  9F75  RETURN

9F76 ********** SET MODE AND CSWL/KSWL *****************************

  9F76  STORE "STATE" MODE FROM X REGISTER (BE42)
  9F7B  COPY PROPER CSWL/KSWL VALUES TO REDIRECT... (B7F7)
  9F7E  VECTOR DEPENDING ON CURRENT MODE (BE38)
  9F87  RETURN

9F88 ********** PRINTERR: PRINT ERROR MSG **************************

  9F88  ---
  9F89  GET INDEX INTO PACKED MESSAGE TEXTS (BA13)
  9F8C  UNPACK MESSAGE INTO $201 <9FB0>
  9F92  SAVE THE LENGTH (BCB6)
  9F95  SKIP A LINE <9FAB>
  9F9A  PRINT A BELL <9FAD>
  9F9D  ---
  9F9F  PRINT CONTENTS OF $201 MSG BUFFER (0201)
  9FAB  PRINT A RETURN CHARACTER
  9FAD  AND EXIT >>FDED
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9FAD
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

9FB0 ********** UNPACK ERROR MESSAGE ********************************

  9FB0  NOTHING IN BUFFER AT FIRST
  9FB6  GET A NIBBLE FROM PACKED MSG <9FD2>
  9FB9  NON-ZERO, COMMON CHARACTER >>9FC0
  9FBB  IF ZERO, GET NEXT NIBBLE <9FD2>
  9FBE  AND CONVERT TO UNCOMMON CHAR INDEX
  9FC0  ---
  9FC1  GET THE LETTER THIS NIBBLE REPRESENTS (BA28)
  9FC4  ZERO? THEN END OF MESSAGE >>9FD1
  9FC6  GET INDEX INTO OUTPUT BUFFER (BE4B)
  9FC9  AND STORE THE CHARACTER THERE (0201)
  9FCC  BUMP INDEX (BE4B)
  9FCF  AND CONTINUE >>9FB6
  9FD1  RETURN

9FD2 ********** UNPACK MESSAGE BYTE *********************************

  9FD2  GET NEXT MSG BYTE (BA48)
  9FD5  WORKING ON SECOND NIBBLE? >>9FE9
  9FD7  NO, TAB INDICATOR? >>9FDF
  9FD9  NO, ISOLATE HIGH NIBBLE
  9FDD  NEXT TIME GET LOW NIBBLE
  9FDE  RETURN

  9FDF  ---
  9FE0  GET TAB POSITION (BA48)
  9FE3  AND BUMP OUTPUT PTR ACCORDINGLY (BE4B)
  9FE7  THEN GO BACK FOR NEXT NIBBLE >>9FD2

  9FE9  BUMP BYTE PTR FOR NEXT TIME
  9FEA  ISOLATE LOW NIBBLE
  9FEC  NEXT TIME GET HIGH NIBBLE
  9FED  RETURN

9FEE ********** WRITE ONE BUFFERED BYTE ****************************

  9FEE  SET UP COUNT OF 0001
  9FF2  AND JUMP INTO ROUTINE BELOW >>A007

9FF4 ********** WRITE BUFFERED DATA/TEST ERROR **********************

  9FF4  WRITE BUFFERED DATA <A000>
  9FF7  OK? THEN EXIT >>A01C
  9FFA  ERROR, POP OUT OF THIS SUBROUTINE
  9FFD  AND GO TO ERROR HANDLER >>9AF0
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 9FFD
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

A000 ********** WRITE ALL BUFFERED DATA ****************************

  A000  ---
  A002  GET BUFFERED DATA COUNT (BE4A)
  A005  NONE BUFFERED? >>A01B
  A007  STORE BUFFERED DATA COUNT IN RW PARMS (BED9)
  A00F  MLI: WRITE <BE70>
  A015  NOTHING BUFFERED NOW, COUNT=0 (BE4A)
  A019  ERROR? >>A01C
  A01B  NO, EXIT
  A01C  RETURN

A01D ********** SPECIAL GARBAGE COLLECT ****************************
         (PULL OUT STRING CONSTANTS ALSO)

  A01D  DO GARBAGE COLLECTION NORMALLY FIRST <A044>
  A020  ERROR? >>A043
  A024  START OF STRING AREA = PROGRAM START PTR (BC84)
  A02C  USE GENERAL PURPOSE BUFFER (ABOVE HIMEM)
  A02E  FOR A GARBAGE COLLECT WORKAREA (BC7D)
  A033  IT IS 3+1 PAGES IN LENGTH (BC7E)
  A038  END OF STRING AREA IS AT END OF FREEAREA (BC86)
  A040  GO COLLECT CONSTANT STRINGS NOW <A085>
  A043  THEN EXIT

A044 ********** "FRE" COMMAND ***************************************
         (FAST APPLESOFT STRING GARBAGE COLLECTION)
```




```
         TOP PART OF OLD STRINGS IS SAVED IN THE
         GENERAL PURPOSE BUFFER OR IN THE FREE
         AREA (WHICHEVER IS LARGER) AND A NEW
         COPY OF THE STRINGS IS BUILT JUST BELOW
         HIMEM.
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A044
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

 A044  STRING AREA START IS ON PAGE BOUNDARY
 A04B  ASSUME 4 PAGE WORKAREA (BC7E)
 A050  IN GENERAL PURPOSE BUFFER ABOVE HIMEM (BC7D)
 A055  STRING START PTR IS START OF STRING AREA (BC84)
 A059  COMPUTE NUMBER OF FREE PAGES
 A05B  AT LEAST 7?
 A05D  IF NOT, USE G.P. WORKAREA INSTEAD >>A079
 A05F  DON'T USE ALL OF FREE AREA (LEAVE $300)
 A061  NEW WORKAREA SIZE IS FREE AREA SIZE-$300 (BC7E)
 A066  SET PTR TO WORKAREA AT FIRST FREE PAGE
 A06D  COMPUTE NUMBER OF STRING PAGES
 A071  USE SMALLER OF STRING PAGES OR WORKAREA SIZE (BC7E)
 A076  AS NEW WORKAREA SIZE (BC7E)
 A079  END OF STRING AREA IS HIMEM
 A085  RECORD WHETHER LAST PAGE IS PARTIAL
 A089  STRING START MSB IS HIMEM INITIALLY (BC86)
 A08E  ADJUST LORANGE AND HIRANGE MSB'S
 A090  FOR PARTIAL PAGES AT EITHER END, (BC7F)
 A093  SETTING THEM AT HIMEM FOR NOW.
 A09C  SET UP ARRAY END MSB +1 FOR COMPARES (BC82)
 A09F  $3E/$3F --> FIRST VARIABLE (LESS 7 BYTES)
 A0A1  (EACH VARIABLE IS 7 BYTES)
 A0AB  SET UP ARRAY START LSB FOR COMPARES
 A0B0  GET LORANGE VALUE (BC7F)
 A0B3  PRIOR TO STRING AREA? (BC84)
 A0B6  YES, THEN DONE! >>A0F6
 A0B8  ELSE, DROP LORANGE BY WORKAREA SIZE (BC7E)
 A0BB  AND SAVE THIS VALUE (BC7C)
 A0BE  NOW DROP IT ALSO BY THE DISTANCE BETWEEN
 A0C0  ...THE OLD LORANGE AND THE STRING START PTR (BC7F)
 A0CA  USE THE LOWER OF THE TWO VALUES (BC7C)
 A0CF  TO PRODUCE THE MAXIMUM SIZED RANGE  (BC7C)
 A0D2  IS THIS BELOW THE BOTTOM OF THE STRINGS? (BC84)
 A0D5  NO >>A0DC
 A0D7  YES, USE THE BOTTOM POINTER INSTEAD (BC84)
 A0DA  (ADJUSTING FOR PARTIAL PAGE)
 A0DC  STORE FINAL LORANGE VALUE (BC7F)
 A0DF  COPY SOME PAGES BELOW HIRANGE TO WORKAREA <A195>
 A0E2  (TO MAKE ROOM FOR NEW STRINGS)
 A0E4  COLLECT SIMPLE STRING VARS FOR THIS RANGE <A0F7>
 A0E7  ERROR? >>A0F4
 A0E9  THEN COLLECT STRING ARRAYS <A12D>
 A0EC  NEW HIRANGE = OLD LORANGE (BC7F)
 A0F2  CONTINUE LOOPING >>A09F

 A0F4  IF ERROR, "RAM TOO LARGE"
 A0F6  EXIT TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A0F6
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

A0F7 ********** COLLECT SIMPLE STRINGS ******************************

 A0F7  ---
 A0F8  ADD 7 BYTES TO $3E/$3F PTR FOR NEXT VAR
 A102  PTR AT ARRAYS NOW?
 A108  IF SO, WE ARE DONE >>A12B
 A10A  IS THIS A STRING VARIABLE?
 A111  NO >>A0F7
 A113  MAKE ABSOLUTELY SURE
 A117  GET MSB OF STRING POINTER
 A11B  IS IT WITHIN MY RANGE? (BC7F)
 A11E  NO >>A0F8
 A123  NO >>A0F7
 A125  YES, PULL IT OUT AND TACK IT TO HIMEM <A1B8>
 A128  ALL WENT WELL, GET NEXT VARIABLE >>A0F8
 A12A  IF ERROR, EXIT NOW

 A12B  NORMAL EXIT TO CALLER
 A12C  RETURN

A12D ********** COLLECT STRING ARRAYS ******************************

 A12D  FIND THE NEXT ARRAY <A15C>
 A130  NO MORE? >>A12B
 A132  GOT ONE, GET MSB OF ITS STRING PTR
 A136  WITHIN MY RANGE? (BC7F)
 A139  NO >>A146
 A13E  NO >>A146
 A140  YES, PULL IT OUT AND TACK IT TO HIMEM  <A1B8>
 A143  AND CONTINUE WITH NEXT ARRAY ELEMENT >>A147
 A145  ERROR EXIT

 A146  ---
 A147  BUMP POINTER TO NEXT ARRAY MEMBER
 A151  POINTER NOW AT NEXT ARRAY? (BC81)
 A154  NO, DO THIS ELEMENT >>A132
 A158  NO >>A132
 A15A  YES, SET UP TO PROCESS THAT ONE THEN >>A12D

A15C ********** FIND NEXT STRING ARRAY ******************************

 A15C  ---
 A15D  $3E --> ARRAY VARIABLES (BC81)
 A164  AT END OF ARRAY VARS
 A166  NO, CONTINUE >>A16C
 A16A  YES, OUT (CARRY SET, NO MORE ARRAYS) >>A194
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A16A
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  A16C  POINT TO ARRAY FOLLOWING THIS (LSB AND...)
  A176  MSB TO X REGISTER
  A17D  CHECK TYPE OF VARIABLE
  A182  SKIP INTEGER AND REAL ARRAYS >>A15C
  A186  GET NUMBER OF DIMENSIONS
  A188  *2 TO SKIP SIZES
  A189  +5 TO SKIP FIXED STUFF AT BEGINNING
  A18D  POINT TO FIRST ARRAY MEMBER
  A191  READY TO ROLL, $3E POINTS TO IT
  A194  RETURN

A195 *********** COPY PAGES TO WORKAREA *****************************
          TO MAKE ROOM FOR NEW STRINGS BEING MOVED
          TO HIMEM, COPY SOME STRING PAGES FROM OLD
          STRING AREA TO THE WORKAREA TO PROTECT THEM.

  A195  $3A/$3B --> FIRST PAGE TO SAVE (BC7C)
  A19A  $3C/$3D --> WORKAREA (BC7D)
  A1A5  COPY N+1 PAGES (SIZE OF WORKAREA) (BC7E)
  A1A9  ---
  A1B7  EXIT WHEN FINISHED

A1B8 *********** PULL STRING OUT ************************************
          TACK STRING JUST UNDER HIMEM AT CURRENT
          STRING START POINTER.

  A1B8  IS STRING BELOW SAVED AREA? (BC7C)
  A1BB  YES, ITS STILL THERE THEN >>A1C4
  A1BD  ELSE, POINT TO SAVED STRING IN WORKAREA (BC7C)
  A1C4  $3A/$3B --> STRING
  A1CF  DROP STRING START PTR BY LEN OF THIS STRING
  A1D4  UPDATE STRING'S LSB IN VARIABLE PTR
  A1D8  FIX UP MSB OF STRING START PTR ALSO
  A1DD  AND OF VARIABLE PTR
  A1E1  IS THIS A NULL LENGTH STRING?
  A1E3  YES, NO MOVE TO DO >>A1EE
  A1E6  ---
  A1E7  ELSE, COPY STRING OUT
  A1EE  ---
  A1EF  OUT OF FREESPACE? (BC82)
  A1F4  RETURN TO CALLER WITH INDICATION

A1F5 *********** ALLOCATE BUFFER ************************************

  A1F5  NEED 4 PAGES
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A1F5
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

          ******** GENERAL PURPOSE ALLOCATE *******

  A1F7  STORE THAT (BB47)
  A1FA  GO GARBAGE COLLECT TO GET SPACE <A044>
  A1FD  ERROR? >>A24A
  A201  HOW MANY FREE PAGES ARE THERE?
  A203  ARE THERE ENOUGH? (BB47)
  A206  IF NOT, "RAM TOO LARGE" MSG
  A208  TOO FEW... >>A24A
  A20A  GOT ENOUGH, $3A-->TOP OF FREESPACE
  A211  AND $3C-->NEW TOP AFTER ALLOCATION
  A21B  COMPUTE LENGTH OF STRINGS FOR COPY
  A229  COPY STRINGS DOWN "N" PAGES IN MEMORY <A35B>
  A22F  SUBTRACT "N" FROM STRING ADDRESS MSB'S (BB47)
  A235  ADJUST ALL POINTERS IN SIMPLE & ARRAY VARS <A39F>
  A23A  OLD HIMEM BECOMES BUFF ADDR HIGH WATER MARK (BB49)
  A241  NEW HIMEM IS "N" PAGES LOWER
  A246  FIND PAGE JUST BEYOND A FILE BUFFER (BC88)
  A249  RETURN
  A24A  ---
  A24B  RETURN

A24C *********** FREE BUFFER ****************************************

  A24C  GARBAGE COLLECT STRINGS <A044>
  A24F  ERROR? >>A299
  A255  PUT HIMEM-$100 INTO $3A/3B
  A259  AND HIMEM+$400 INTO $3C/3D
  A25F  (COPY LSB'S)
  A266  BC92 = LENGTH OF STRINGS (BC92)
  A270  COPY STRINGS UP 4 PAGES <A37F>
  A275  PREPARE TO ADJUST THEM BY $400 (BC87)
  A27B  NEW HIMEM+$400
  A27D  ADJUST ALL STRING ADDRS UP BY $400 <A39F>
  A283  ARE WE FREEING BOTTOM-MOST BUFFER?
  A285  YES, DONE! >>A2B3
  A288  CHECK OPEN FILE COUNT (BE4D)
  A28B  NONE OPEN? (HOW CAN THAT BE?) >>A297
  A28D  WHICH FILE'S BUFFER IS NEXT TO HIMEM?
  A292  SEARCH UNTIL IT IS FOUND... >>A29A
  A297  ---
  A299  RETURN IF NO FILE IS USING THIS BUFFER
  A29A  ---
  A29B  GIVE THAT FILE THE BUFFER PASSED TO US (BEC9)
  A29E  (SURE HOPE THAT FILE WAS FLUSHED!) (BC93)
  A2A9  PASS FILE REF NUM TO MLI (BEC7)
  A2AE  MLI: SET NEW BUFFER <BE70>
  A2B1  ERROR? >>A299
  A2B3  ---
  A2B4  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A2B4
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

A2B5 *********** GETBUFR: GET A BUFFER *******************************
          THIS ROUTINE IS CALLED THROUGH AN EXTERNAL
          ENTRY POINT IN THE GLOBAL PAGE.  IT ALLO-
          CATES A FIXED LOCATION BUFFER BETWEEN THE
          BI AND ITS BUFFERS.

  A2B5  ALLOCATE A BUFFER OF ANY SIZE (A=PAGES) <A1F7>
  A2B8  ERROR? >>A300
  A2BD  FIND FIRST PAGE OF BUFFER (BB4A)
  A2C4  GET FILE OPEN COUNT (BE4D)
  A2C7  NONE OPEN? >>A2EA
  A2C9  BUMP BUFFER PAGE PTR BY $400 (BB49)
  A2CD  TO POINT TO PREVIOUSLY ALLOCATED
  A2CF  BUFFER. (BB49)
  A2D2  FIND OPEN FILE WITH THIS BUFFER (BC93)
  A2D7  GOT IT, (BEC9)
  A2DA  SET FILE BUFFER REAL LOW IN MEMORY <A352>
  A2DD  THEN SET IT TO NEW BUFFER LOCATION  <A29B>
  A2E0  BELOW ALL OTHERS (BEC9)
  A2E7  DO THIS FOR EACH OPEN FILE...
  A2E8  THEREBY INSERTING A BLANK BUFFER >>A2D2
  A2ED  IS EXEC FILE ACTIVE? (BE43)
  A2F0  NO, DONE >>A2FF
  A2F2  YES,
  A2F4  MOVE EXEC BUFFER DOWN ALSO <A352>
  A2FD  AND BUMP UP ABOVE IT
  A2FF  EXIT TO CALLER
  A300  RETURN

A301 *********** FREEBUFR: FREE BUFFER *******************************
          THIS ROUTINE IS CALLED THROUGH AN EXTERNAL
          ENTRY POINT IN THE GLOBAL PAGE.  IT FREES
          A FIXED LOCATION BUFFER PREVIOUSLY ALLO-
          CATED BY GETBUFR.

  A301  GET COUNT OF OPEN FILES (BE4D)
  A305  INDEX THIS BY 4 PAGES PER FILE
  A306  ADD TO HIMEM MSB
  A30B  SAVE THIS AS TOP OF BUFFERS (BB49)
  A30D  THEN SET UP BOTTOM AS HIMEM MSB (BB4A)
  A310  GET OLD ORIGINAL HIMEM (BEFORE ANY BUFFERS) (BEFB)
  A313  SAME AS THIS ONE?
  A315  THEN NOTHING ELSE TO DO >>A350
  A317  ASSUME NO BUFFERS BY REPLACING OLD HIMEM
  A319  ANY EXEC FILE OPEN? (BE43)
  A31C  NO, CONTINUE >>A323
  A31E  YES, MOVE EXEC BUFFER TO OLD HIMEM <A2F2>
  A321  AND GO MOVE HIMEM DOWN BY $400 >>A341
  A323  ELSE, START WITH TOP BUFFER (BB49)
  A326  ANY OPEN FILES? (BE4D)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A329
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A329  IF NOT, WE ARE DONE >>A34D
  A32B  SEARCH FOR OPEN FILE WITH THIS BUFFER (BC93)
  A32E  NOT IT? >>A34A
  A330  GOT IT, GIVE IT NEW HOME AT HIMEM
  A332  AND SET BUFFER LOW <A352>
  A335  THEN TO NEW LOC <A29B>
  A339  DROP TOP BUFFER PTR BY $400 (BB49)
  A341  AND DROP HIMEM BY $400
  A348  AND GO DO NEXT BUFFER >>A323
  A34A  ---
  A34B  (LOOP TO SEARCH FOR OPEN FILES) >>A32B
  A34D  WHEN FINISHED, GARBAGE COLLECT <A044>
  A350  ---
  A351  THEN EXIT NORMALLY TO CALLER

          ******** SET BUFFER BELOW ALL OTHERS ***

  A352  ---
  A353  USE BOTTOM BUFFER PTR (BB4A)
  A356  SET FILE BUFFER <A29B>
  A35A  AND EXIT

A35B *********** COPY BLOCK DOWN IN MEMORY ***************************

  A35B  COPY ALL FULL PAGES DOWN TO THEIR NEW HOME
  A362  COPYING $3A-->$3C
  A369  BUMP BOTH MSB'S
  A36D  DROP PAGE COUNTER (BC93)
  A370  AND CONTINUE >>A362
  A372  NO SHORT LAST PAGE? (BC92)
  A375  THEN EXIT NOW >>A37E
  A377  ELSE, COPY PARTIAL PAGE
  A37E  THEN EXIT

A37F *********** COPY BLOCK UP IN MEMORY *****************************

  A37F  PARTIAL PAGE? (BC92)
  A382  NO, JUST COPY FULL PAGES NOW >>A38B
  A384  YES, COPY SHORT PAGE FIRST <A396>
  A3B7  DROP BOTH MSB'S
  A38B  PAGE COUNT GONE TO ZERO? (BC93)
  A3BE  YES, DONE >>A39E
  A390  ELSE, DROP PAGE COUNT (BC93)
  A393  AND GO COPY A FULL PAGE UP >>A384

  A396  ---
  A397  COPY REMAINDER OF PAGE UP (BACKWARDS)
  A39E  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A39E
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

A39F ********** ADJUST ALL STRING ADDRS ****************************
         (BC87 HAS ADDITIVE ADJUSTMENT FACTOR)

  A39F  USE LOMEM PAGE AS MSB FOR $3E/3F
  A3A3  GET LOMEM LSB
  A3A5  AND END OF SIMPLE VARS PAGE
  A3A8  JUMP INTO THE LOOP >>A3AF
  A3AA  ---
  A3AB  SKIP ONE SIMPLE VARIABLE
  A3AF  ---
  A3B1  OVERFLOW? >>A3B5
  A3B3  YES, BUMP MSB
  A3B5  FINISHED WITH SIMPLE VARS?
  A3B9  (CHECK BOTH MSB AND LSB OF PTR)
  A3BB  ---
  A3BC  YES... >>A3D2
  A3BE  NO,
  A3C0  LOOK AT A SIMPLE VARIABLE
  A3C5  SKIP INTEGER AND REAL VARS >>A3AA
  A3C7  (DOUBLE CHECK MSB)
  A3CB  ITS A STRING, POINT TO ITS LEN/ADDR
  A3CC  ADJUST IT IF NECESSARY <A3F9>
  A3CF  THEN SKIP OVER IT >>A3AA

  A3D2  COPY ARRAYS STARTING LSB
  A3D4  (MSB IS IN X REGISTER NOW) (BC8I)
  A3D7  ---
  A3D8  FIND A STRING ARRAY <A15C>
  A3DB  NO MORE? THEN DONE... >>A40C
  A3DD  ---
  A3E0  ADJUST ITS ADDRESS IF NEED BE <A3F9>
  A3E6  SKIP TO NEXT STRING ELEMENT OF ARRAY
  A3EE  AT END OF THIS ARRAY YET? (BC81)
  A3FI  NO... >>A3DD
  A3F3  (CHECK MSB ALSO)
  A3F7  YES..., GO GET NEXT ARRAY >>A3D7

A3F9 ********** ADJUST A STRING ADDRESS ****************************

  A3F9  GET STRING LENGTH
  A3FB  IGNORE NULL STRINGS >>A40C
  A3FD  POINT TO MSB OF ADDRESS
  A3FF  IS STRING STORED OUTSIDE OF PROGRAM?
  A403  NO, LEAVE IT ALONE >>A40C
  A405  STORE ABOVE LOMEM, ADD FACTOR TO MSB
  A40C  THEN EXIT
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A40C
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

A40D ********** COMPRESS ALL ASOFT VARS ****************************
         THIS ROUTINE SQUASHES ALL APPLESOFT VARS
         UP AGAINST THE BOTTOM OF THE STRINGS
         HIMEM -->  ------------------------
                    |                      |
                    |       STRINGS        |
                    |                      |
                    ------------------------
                    |                      |
                    |       ARRAY VARS     |
                    |                      |
                    ------------------------
                    |                      |
                    |       SIMPLE VARS    |
                    |                      |
                    ------------------------

  A40D  GARBAGE COLLECT FIRST <A01D>
  A410  ERROR? >>A47I
  A412  COMPUTE LENGTH OF SIMPLE AND ARRAY VARS
  A4I7  AND SAVE IT (BC89)
  A427  NEXT, COMPUTE LENGTH OF SIMPLE VARS ONLY
  A42B  AND SAVE IT (BC8B)
  A435  SUBTRACT VAR LENGTH FROM STRING START
  A437  TO FIND A PLACE TO PUT THE VARS UNDER (BC92)
  A43A  THE STRINGS (START ON AN EVEN PAGE BOUND)
  A440  $3C/$3D --> PLACE TO PUT VARS
  A447  $3A/$3B --> START OF VARS (ROUNDED TO EVEN
  A449              PAGE ALIGNEMENT)
  A44F  COPY VARS UP AGAINST STRINGS <A37F>
  A454  STORE START OF VARS PTR (BC8E)
  A457  BUMPING PAGE NUMBER BY ONE
  A463  SUBTRACT THIS PTR FROM HIMEM TO COMPUTE (BC90)
  A466  TOTAL LENGTH OF COMBINED VARS/STRINGS
  A468  AND SAVE THIS TOO (BC8D)
  A46B  ALSO, SAVE HIMEM MSB IN CASE THEY ARE MOVED
  A47I  DONE, EXIT

A472 ********** REEXPAND COMPRESSED VARS ****************************
         THIS ROUTINE MOVES SIMPLE AND ARRAY VARS
         BACK DOWN TO LOMEM.
         HIMEM -->  ------------------------
                    |                      |
                    |       STRINGS        |
                    |                      |
                    ------------------------
                    |                      |
                    |                      |
                    /     FREE SPACE       /
                    /                      /
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A472
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

                    |                       |
                    |                       |
                    -------------------------
                    |                       |
                    |      ARRAY VARS       |
                    |                       |
                    -------------------------
                    |                       |
                    |      SIMPLE VARS      |
                    |                       |
          LOMEM --> -------------------------

  A472  SAVE LENGTH OF SIMPLE AND ARRAY VARS (BC89)
  A479  ADD THIS TO START OF COMPRESSED VARS PTR
  A47B  TO GIVE START OF STRINGS ($6D/$6E)
  A487  $3C/$3D --> LOMEM (WHERE TO PUT SIMPLE VARS)
  A48E  $6B/$6C --> WHERE TO PUT ARRAY VARS
  A499  $3A/$3B --> START OF COMPRESSED VARS (BC8E)
  A4A3  COPY SIMPLE/ARRAY VARS DOWN TO LOMEM <A35B>
  A4AA  COMPUTE START OF STRINGS BY ADDING VARS
  A4AC  LENGTH TO VARS ORIGIN
  A4B5  DID HIMEM MOVE SINCE VARS WERE COMPRESSED?
  A4BA  NO... >>A4C2
  A4BC  YES, ADJUST BY DIFFERENCE IN HIMEM'S (BC87)
  A4BF  GO ADJUST ALL STRING POINTERS <A39F>
  A4C2  THEN EXIT
  A4C3  RETURN

A4C4 *********** FORMAT CATALOG ENTRY LINE ***************************

  A4C4  PUT OUT A BLANK LINE <A66C>
  A4C7  DOUBLE QUOTE TO $20Ø
  A4CC  GET LENGTH OF NAME (Ø259)
  A4D2  COPY NAME TO LINE (Ø259)
  A4DD  ZERO ACCUMULATOR FOR LATER (BCB1)
  A4EØ  GET FILE TYPE (Ø269)
  A4E3  I KNOW OF ONLY 13
  A4E5  ---
  A4E7  LOOK UP FILE TYPE IN TABLE (B989)
  A4EA  FOUND IT? >>A4F7
  A4FØ  FILE TYPE NOT IN MY TABLE
  A4F2  PRINT IT IN HEXADECIMAL <A612>
  A4F5  AND CONTINUE BELOW >>A53B
  A4F7  ELSE, FOR KNOWN TYPES
  A4FA  COPY NAME OF TYPE TO THE LINE (B997)
  A5Ø5  8Ø COLUMNS PER LINE? (BCB6)
  A5Ø8  YES... >>A553
  A5ØA  NO,
  A5ØC  BIN FILE?
  A5ØE  YES... >>A525
  A51Ø  TXT FILE?
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A512
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A512  NO... >>A53B
  A514  YES, R VALUE GIVEN AS SUBTYPE
  A51F  CONVERT R VALUE TO DECIMAL <A62F>
  A522  SKIP OVER BIN CODE >>A536
  A525  BIN FILE, USE AD VALUE AS SUBTYPE
  A52D  CONVERT IT TO TWO HEX DIGITS <A612>
  A536  ADD AN "=" SIGN
  A53B  COPY MSB OF END OF FILE MARK (Ø27Ø)
  A549  CONVERT LOW TWO BYTES OF EOF <A62F>
  A55Ø  DO CREATION DATE/TIME <A57Ø>
  A553  ---
  A55B  CONVERT BLOCKS USED <A62F>
  A563  CHECK FOR WRITE ACCESS
  A565  UNLOCKED? >>A56C
  A567  NO, ADD A "*"
  A56C  FALL THRU TO DO LAST MODIFIED DATE/TIME
  A56E  AND THEN EXIT TO CALLER

A57Ø *********** FORMAT A DATE/TIME ********************************
          X = OFFSET FROM $259 TO FIELD
          Y = $201 OFFSET TO DATE/TIME VALUE

  A57Ø  ISOLATE YEAR (Ø25A)
  A574  AND STORE IT (BCB5)
  A57B  ISOLATE DAY
  A57D  AND STORE IT (BCB4)
  A581  ISOLATE MONTH
  A587  (MONTH = Ø IS NO GOOD) >>A5A3
  A58B  (MONTH > 12 IS ALSO BAD) >>A5A3
  A58D  STORE MONTH (BCB3)
  A591  MULTIPLY MONTH INDEX BY 3 (BCB3)
  A594  AND SAVE IT INSTEAD (BCB3)
  A59A  (DAY = Ø IS NO GOOD) >>A5A3
  A5A1  (YEAR MUST BE < 99) >>A5B5

  A5A3  OTHERWISE, BAD DATE!
  A5A5  BACK UP 6 CHARACTERS ON LINE
  A5AA  AND PRINT "<NO DATE>" (B9E5)
  A5B4  THEN EXIT RIGHT AWAY

  A5B5  DATE OK, GET HOUR (Ø25C)
  A5B9  AND MINUTES (Ø25B)
  A5BE  MINUTES > 6Ø?
  A5CØ  NO.. >>A5C3
  A5C2   YES, USE ZERO MINUTES
  A5C3  CONVERT MINUTES (LEFT ZERO FILL) <A6ØA>
  A5C8  THEN PRINT A ":" (Ø2Ø1)
  A5CC  GET HOUR AGAIN
  A5CF  GREATER THAN 24 HOURS?
  A5D1  NOPE >>A5D4
  A5D3  YES, USE ZERO
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A5D4
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A5D4  1Ø OR MORE HOURS (TWO DIGITS?)
  A5D7  IN ANY CASE, CONVERT HOURS <A62F>
  A5DB  IF TWO DIGITS... >>A5DE
  A5DD  IF ONE, ADJUST LINE PTR
  A5DE  ---
  A5E2  CONVERT YEAR (LEFT ZERO FILL) <A60A>
  A5E6  GET MONTH INDEX (*3) (BCB3)
  A5E9  POINT TO LAST CHARACTER
  A5EC  COPY MONTH NAME FROM TABLE (B9BD)
  A5EF  TO LINE (Ø201)
  A5F7  BACKWARDS... >>A5EC
  A5FB  PUT A "-" IN (Ø201)
  A5FE  TWO PLACES (Ø205)
  A607  EXIT BY CONVERTING DAY >>A62F

A60A *********** CONVERT 2 DIGIT NUMBER ******************************
         (FORCE LEFT ZERO FILL)

  A60A  ---
  A60B  ADD 1ØØ TO FORCE SIGNIFICANCE IN TENS
  A60D  CONVERT IT <A62F>
  A610  IGNORE 1ØØ'S PLACE
  A611  RETURN

A612 *********** CONVERT TO HEX ************************************

  A612  ---
  A613  ISOLATE LOW NIBBLE
  A615  AND GO CONVERT IT FIRST <A61D>
  A619  NOW ISOLATE HIGH NIBBLE
  A61C  AND FALL THRU TO CONVERT IT ALSO

  A61D  CONVERT NIBBLE TO NUMERIC ASCII
  A61F  >9?
  A621  NO >>A625
  A623  YES, CONVERT $BA-$BF TO $C1-$C6
  A625  AND STORE THE RESULT (Ø201)
  A628  BUMP LINE INDEX BACK
  A629  PRECEED WITH A $ SIGN
  A62E  RETURN

A62F *********** CONVERT TO DECIMAL **********************************

  A62F  A,X = NUMBER     Y=INDEX TO LAST FIELD DIGIT (BCBØ)
  A632  STORE NUMBER IN ACCUMULATOR (BCAF)
  A635  DIVIDE BY 1Ø <A64D>
  A638  GET DIGIT AND CONVERT IT (BCB2)
  A63D  STORE IN LINE (Ø201)
  A640  AND DROP LINE INDEX BY ONE
  A641  IS QUOTIENT NOW ZERO? (BCAF)
  A64A  NO, CONTINUE UNTIL IT IS >>A635
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A64C
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A64C  ELSE, EXIT

        ******** DIVIDE ACCUMULATOR BY 1Ø *******

  A64D  24 BIT SHIFT (3 BYTES)
  A651  CLEAR SUM (BCB2)
  A654  GO ROL ACCUMULATOR LEFT ONE BIT <AAD7>
  A657  ALSO ROL 4TH BYTE OF ACCUM (BCB2)
  A65B  IF MSB > 1Ø... (BCB2)
  A665  THEN ADD ONE TO ACCUMULATIVE SUM (BCAF)
  A668  ---
  A669  SHIFT 24 TIMES >>A654
  A66B  RETURN
  A66C  ---
  A676  RETURN

A677 *********** SYNTAX: PARSE COMMAND LINE *************************
        (ALSO EXTERNAL ENTRY FOR COMMAND STRINGS)

  A677  INIT COMMAND NUMBER TO -1
  A67E  A BLANK ENDS EACH STRING  (BCA9)
  A683  AT MOST 8 CHARACTERS IN A COMMAND (BCAA)
  A686  PARSE COMMAND ITSELF <AA1B>
  A689  GET FIRST LETTER (BCBD)
  A68C  MUST BE ALPHABETIC
  A68E  IT IS... >>A697
  A690  IT'S NOT, IS IT A "-"?
  A692  YES, OK THEN... >>A697
  A694  ELSE, ITS BAD - SYNTAX ERROR >>A839
  A697  SCAN FOR COMMAND IN TABLES <AAE1>
  A69A  BAD COMMAND? >>A694
  A69C  NO, IMMEDIATE COMMAND MODE? (BE42)
  A69F  NO, DEFERRED... >>A6AC
  A6A1  IMMEDIATE, EXEC ACTIVE? (BE43)
  A6A4  YES, NEVER MIND >>A6AC
  A6A6  ERASE TO END OF LINE <FC9C>
  A6A9  AND GO TO A NEW LINE ON SCREEN <9FAB>
  A6AC  ASSUME NO PARMS AT ALL
  A6B4  NO PATH NAME YET (BCBD)
  A6B7  NO SECONDARY PATH NAME EITHER (Ø280)
  A6BD  CURRENT SLOT = DEFAULT SLOT (BE61)
  A6C3  CURRENT DRIVE = DEFAULT DRIVE (BE62)
  A6C8  BUFFER ALLOCATION = HIMEM (BC88)
  A6CB  GET LENGTH OF COMMAND NAME (BE52)
  A6D0  ALLOW 2 MORE CHARACTERS FOR NOW (BCAA)
  A6D3  ARE ANY PARAMETERS PERMITTED? (BE54)
  A6D6  NO...MUST BE MON OR NOMON >>A736
  A6D8  YES, IN# OR PR#?
  A6D9  YES... >>A739
  A6DB  ELSE, REPARSE THE COMMAND <AA1B>
  A6E0  FOR THIS COMMAND... (BE54)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A6E3
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

 A6E3  DOES THE PREFIX NEED FETCHING? >>A6EA
 A6E5  YES,
 A6E7  MLI: GET PREFIX FROM DEFAULT DRIVE <BE70>
 A6EA  ---
 A6EC  END OF LINE? >>A736
 A6EE  NO, COMMA?
 A6F0  NO >>A6F5
 A6F2  YES, NO FILENAME, LOOK FOR KEYWORDS >>A787
 A6F5  "/"?
 A6F7  YES >>A6FD
 A6F9  NO, ALPHABETIC?
 A6FB  NO...FILE NAMES MUST BEGIN THAT WAY >>A72F
 A6FD  ---
 A6FE  DON'T FLUSH ANY BLANKS OUT OF PATHNAME
 A703  ALLOW 64 CHARACTERS NEXT PARSE
 A709  PARSE NEXT OPERAND ON LINE  <AA1F>
 A70D  SAVE ITS LENGTH (BCBC)
 A712  FOUND A PATHNAME#1 (BE56)
 A715  COPY PARM KEYWORD TO $280 (BCBC)
 A718  (ASSUMING PATHNAME1=PATHNAME2) (0280)
 A71F  CHECK NEXT CHAR (OTHER THAN A BLANK) <AA3A>
 A722  NOT COMMA OR RETURN, BAD! >>A72C
 A724  RETURN? >>A798
 A726  NO, PATHNAME EXPECTED NOW? (BE54)
 A72A  YES, ALL IS WELL >>A762
 A72C  NO, "SYNTAX ERROR" >>A839
 A72F  NON ALPHA FILE NAME, CHECK COMMAND NUMBER (BE53)
 A732  IS IT "RUN"
 A734  NO, ERROR >>A72C
 A736  YES, ITS OK THEN (MIGHT BE "RUN 100") >>A798
 A739  IN#S/PR#S, REPARSE COMMAND <AA1B>
 A73C  RETURN FOUND - ERROR >>A72C
 A73E  "A"?  (ADDRESS KEYWORD)
 A740  IF SO, GO PARSE THAT KEYWORD ONLY >>A78C
 A742  ELSE, ZERO ACCUMULATOR <AB37>
 A745  CONVERTING ONE BYTE'S WORTH (BCAD)
 A74A  PUT IT IN PR#/IN# SLOT VALUE AREA (BCAE)
 A74F  FOUND SLOT FOR PR#/IN# (BE56)
 A752  CONVERT SLOT # <A960>
 A755  ERROR? >>A761
 A757  GET CONVERTED VALUE (BE6B)
 A75A  >8?
 A75C  NO, ITS OK >>A791
 A75E  YES, "RANGE ERROR"
 A761  RETURN
 A762  SECOND PATHNAME EXPECTED?
 A763  NO >>A787
 A765  YES, FLUSH TO NON-BLANK <AA3A>
 A768  NOTHING ELSE ON LINE???? >>A72C
 A76B  DON'T FLUSH ANY BLANKS OUT OF PATHNAME
 A772  COPY SECOND PATHNAME TO $281 <AA00>
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A777
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

 A777  SAVE IT'S LENGTH (LESS 1) (0280)
 A77C  FOUND PATHNAME1 AND PATHNAME2 (BE56)
 A780  GET LAST CHARACTER AGAIN <AA3A>
 A783  IF NOT COMMA OR RETURN, "SYNTAX ERROR" >>A72C
 A785  RETURN? >>A798
 A787  NO, COMMA, FLUSH TO NON-BLANK <AA3A>
 A78A  SYNTAX ERROR IF TWO COMMAS IN A ROW >>A72C
 A78C  LOOKUP KEYWORD CHAR AND PARSE ITS VALUE <A8E8>
 A78F  EXIT NOW?  >>A761
 A791  NO, FLUSH TO NON-BLANK <AA3A>
 A794  SYNTAX ERROR IF COMMA OR RETURN NOT FOUND >>A72C
 A796  COMMA? YES, GO GET NEXT KEYWORD >>A787

 A798  GET PARSED SLOT (BE61)
 A79B  MUST BE NON-ZERO >>A75E
 A79D  AND LESS THAN 8
 A79F  OR ELSE - "RANGE ERROR" >>A75E
 A7A1  CHECK DRIVE TOO (BE62)
 A7A6  MUST BE EITHER 1 OR 2
 A7AD  IS THIS A DEFERRED COMMAND?
 A7B0  NO... >>A7BB
 A7B2  YES, IS A PROGRAM RUNNING? (BE42)
 A7B5  YES >>A7BB
 A7B7  NO, "NOT DIRECT COMMAND"
 A7BA  RETURN
 A7BB  EXPECTING NO PATHNAMES? >>A7FD
 A7BD  NO... (BE55)
 A7C0  ARE S AND D VALID FOR THIS CMD?
 A7C2  NO >>A7FD
 A7C4  YES, HAVE WE GOT PATHNAME1? (BE56)
 A7C8  YES >>A7D3
 A7CD  IS PATHNAME REQUIRED?
 A7CF  YES, "SYNTAX ERROR" >>A839
 A7D1  NO, OPTIONAL - NO PREFIX FETCH THEN >>A7FD
 A7D6  DOES PATHNAME1 START WITH A "/"?
 A7D8  YES, FULLY QUALIFIED >>A7DF
 A7DA  NO, IS THERE A PREFIX ACTIVE? (BF9A)
 A7DD  NO >>A7F8
 A7DF  YES, (BE57)
 A7E2  SLOT/DRIVE GIVEN WITH THIS COMMAND?
 A7E4  NO, FORGET IT >>A7FD
 A7E6  YES, DO WE HAVE PATHNAME ALSO? >>A7F8
 A7E8  NO,
 A7EA  NULL OUT PATHNAME1 (BCBC)
 A7F2  MARK THAT WE WILL HAVE ONE SOON (BE56)
 A7F8  ADD PREFIX TO FILENAMES <A83D>
 A7FB  ERROR? >>A83B
 A7FD  GET COMMAND NUMBER (BE53)
 A800  *2 AS INDEX INTO TABLE
 A802  GET ADDRESS OF COMMAND HANDLING ROUTINE (B8E9)
 A80B  AND STORE IT FOR INDIRECT JMP (BCAC)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A810
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A810  EXTERNAL COMMAND? IF SO GO NOW! >>A836
  A812  MY OWN COMMAND, "PREFIX"?
  A814  YES, GO NOW >>A836
  A819  S OR D VALID KEYWORDS FOR THIS CMD?
  A81B  NO, GO NOW >>A836
  A820  PATHNAME1 GIVEN WITH THIS COMMAND?
  A821  NO, GO NOW >>A836
  A823  YES, GET FILE INFO FOR PATHNAME1 <B7D0>
  A826  NO ERRORS I HOPE >>A836
  A828  ERROR WAS PATH NOT FOUND?
  A82A  NO, REAL ERROR - SAY SO >>A83B
  A82F  CAN WE CREATE PATHNAME1?
  A831  YES, OK THEN >>A836
  A833  ELSE, "PATH NOT FOUND"
  A835  RETURN
  A836  GO TO COMMAND HANDLING ROUTINE >>BCAB

A839 *********** SYNTAX ERROR ***************************************

  A839  LOAD BI CODE FOR "SYNTAX ERROR"
  A83B  AND RETURN WITH ERROR CONDITION
  A83C  RETURN

A83D *********** ADD PREFIX TO PATHNAMES ****************************

  A83D  GET SLOT NUMBER (BE61)
  A844  PUT SLOT IN HIGH 3 BITS
  A846  ADD DRIVE TO TOP BIT AND SHIFT SLOT DOWN (BE62)
  A84E  ...TO FORM THE UNIT NUMBER (BEC7)
  A853  READ THE PATHNAME PREFIX TO $201 (BEC8)
  A85D  MLI: ONLINE <BE70>
  A860  ERROR? >>A83B
  A865  DEFAULT DRIVE = PARSED DRIVE (BE3D)
  A86B  DEFAULT SLOT = PARSED SLOT (BE3C)
  A871  PATHNAME1 STARTS WITH "/"?
  A873  THEN ITS ALREADY GOT A PREFIX >>A8E6
  A878  ELSE, GET LENGTH OF PATHNAME
  A87A  BUMP IT BY 2 (TO ALLOW FOR /'S)
  A882  WITH PREFIX WILL IT EXCEED 64 CHARS?
  A887  YES, "SYNTAX ERROR" >>A8E7
  A889  NO, UPDATE LENGTH TO INCLUDE PREFIX (BCBC)
  A88F  ---
  A893  AND COPY PATHNAME1 FORWARD TO MAKE ROOM (BCBD)
  A89C  PUT A "/" AT THE BEGINNING
  A8A1  AND AT THE END (BCBD)
  A8A4  COPY PREFIX JUST READ TO START OF PATHNAME1 (0200)
  A8AA  GET COMMAND NUMBER (BE53)
  A8AD  "OPEN"?
  A8AF  YES, DONE NOW! >>A8E6
  A8B1  "APPEND"?
  A8B3  YES, DONE NOW! >>A8E6
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A8B5
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A8B5  "EXEC"?
  A8B7  YES, DONE NOW! >>A8E6
  A8B9  ELSE, GET LENGTH OF PATHNAME2 (0280)
  A8BE  COMBINE THIS WITH PREFIX LENGTH (0201)
  A8C1  MORE THAN 64 CHARS?
  A8C6  IF SO, "SYNTAX ERROR" >>A8E7
  A8C8  UPDATE LENGTH (0280)
  A8CB  ---
  A8CF  COPY PATHNAME2 FORWARD TO MAKE ROOM (0281)
  A8D8  PUT A "/" IN FIRST
  A8DD  THEN THE PREFIX AND ANOTHER SLASH (0281)
  A8E6  ---
  A8E7  DONE!

A8E8 *********** KEYWORD LOOKUP ***************************************

  A8E8  ZERO THE ACCUMULATOR <AB37>
  A8EB  NINE POSSIBLE KEYWORDS IN TABLE
  A8ED  COMPARE AGAINST EACH (B96B)
  A8F0  FOUND IT? >>A927
  A8F5  NO, IS IT "T"? (FILE TYPE)
  A8F7  YES, OK THEN  >>A8FC
  A8F9  ELSE, BAD KEYWORD >>A839
  A8FC  IT'S "T", IS IT PERMITTED ON THIS CMD?
  A901  NO, ERROR >>A923
  A906  ELSE, MARK WE HAVE "T" (BE56)
  A90B  START WITH TYPE INDEX OF 0 (BCAD)
  A910  INDICATE WHERE T VALUE IS TO GO (BCAE)
  A913  AND GO PARSE ONE CHAR <AA3A>
  A916  NOTHING THERE??? >>A8F9
  A918  IS IT A $?
  A91A  YES, HE GAVE TYPE IN HEX >>A976
  A91C  IS IT ALPHABETIC?
  A91E  NO, CONVERT DECIMAL TYPE >>A960
  A920  ELSE, GO LOOKUP TYPE NAME IN TABLE >>A9B6

  A923  ---
  A924  "INVALID PARAMETER"
  A926  RETURN

  A927  GET BIT POSITION OF THIS KEYWORD (B975)
  A92A  IGNORE "V" >>A947
  A92C  IS THIS KEYWORD PERMITTED? (BE55)
  A92F  NO, NOT WITH THIS COMMAND ANYWAY >>A923
  A931  S OR D?
  A933  NO >>A941
  A935  YES, ALREADY FOUND IT ON THIS LINE? (BE57)
  A938  YES, DON'T CHANGE DRIVE DEFAULT >>A947
  A93A  ELSE, ASSUME DRIVE = 1
  A941  MARK WE HAVE SLOT/DRIVE (BE57)
  A947  GET SIZE-1 IN BYTES OF VALUE (B97F)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A954
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A954  AND OFFSET TO VALUE IN STORAGE AREA (BCAE)
  A957  FLUSH TO NON-BLANK <AA3A>
  A95A  NOTHING ELSE THERE? >>A9B0
  A95C  IS NEXT CHAR A "$"?
  A95E  YES, GO CONVERT HEX - ELSE, FALL THRU >>A976

A960 ********** CONVERT DECIMAL NUMBER ******************************

  A960  SAVE LINE INDEX (BE4B)
  A963  CONVERT/ADD ONE DECIMAL DIGIT TO ACCUM <AA5C>
  A966  OK.. >>A96C
  A968  OVERFLOW? THEN "RANGE ERROR" >>A9B3
  A96A  BAD DIGIT? THEN "SYNTAX ERROR" >>A9B0
  A96C  RESTORE LINE INDEX (BE4B)
  A96F  FLUSH TO NEXT NON-BLANK <AA3A>
  A972  AND GO BACK TO CONVERT NEXT DIGIT >>A960
  A974  ALL DONE, END OF LINE OR COMMA >>A98F

A976 ********** CONVERT HEX NUMBER **********************************

  A976  FLUSH TO NEXT NON-BLANK (SKIP "$") <AA3A>
  A979  NOTHING LEFT? >>A9B0
  A97B  SAVE LINE INDEX (BE4B)
  A97E  CONVERT HEX DIGIT <AAAE>
  A981  OK.. >>A987
  A9B3  OVERFLOW? THEN "RANGE ERROR" >>A9B3
  A985  BAD DIGIT? THEN "SYNTAX ERROR" >>A9B0
  A987  RESTORE LINE INDEX (BE4B)
  A98A  FLUSH TO NEXT NON-BLANK <AA3A>
  A98D  AND GO CONVERT NEXT DIGIT >>A97B

A98F ********** STORE KEYWORD VALUE **********************************

  A98F  HOW MANY BYTES TO CHECK?
  A994  ALL HAVE BEEN CHECKED? >>A99E
  A996  NO, INSURE MSB'S OF ACCUM ARE ZERO (BCAF)
  A999  IF NUMBER IS A SHORT INTEGER >>A9B3
  A9A1  COPY ACCUM TO PROPER PARM STORAGE CELL (BCAF)
  A9AB  RESTORE LINE INDEX (BE4B)
  A9AF  AND EXIT

  A9B0  "SYNTAX ERROR" JUMP >>AB39
  A9B3  "RANGE ERROR" JUMP >>A75E

A9B6 ********** STORE KEYWORD VALUE **********************************

  A9B6  ---
  A9B8  COPY 3 CHARACTER TYPE TO ACCUM (BCAF)
  A9BE  (COPIED ALL 3?) >>A9C7
  A9C0  (GET NEXT CHAR IGNORING BLANKS) <AA3A>
  A9C5  MUST HAVE 3 CHARACTERS! >>A9B0
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: A9C7
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  A9C7  SAVE LINE INDEX (BE4B)
  A9CA  INITIALIZE NAME INDEX TO ZERO
  A9CF  HAVE ALL 13 BEEN CHECKED?
  A9D1  YES, NO MATCH >>A9B0
  A9D4  ELSE, INDEX*3 (BCAD)
  A9D8  COMPARE TYPE GIVEN (BCAF)
  A9DB  TO TYPES IN TABLE (B997)
  A9DE  (IGNORE MSB'S)
  A9DF  NO MATCH ALREADY... >>A9E9
  A9E3  ELSE,
  A9E5  CHECK ALL THREE CHARS  >>A9D8
  A9E7  THEY ALL MATCH! WE FOUND IT >>A9EE
  A9E9  NOT THE RIGHT ONE, (BCAD)
  A9EC  GO TRY THE NEXT ONE >>A9CA
  A9EE  REVERSE NAME INDEX
  A9F5  AND GET TYPE VALUE FROM TABLE (B989)
  A9F8  STORE IT IN TYPE VALUE STORAGE AREA (BE6A)
  A9FB  RESTORE LINE INDEX (BE4B)
  A9FF  AND EXIT

AA00 ********** COPY PATHNAME2 **************************************

  AA00  GET NEXT CHARACTER <AA4A>
  AA03  AND STORE IT INDEXED OFF $280 (0280)
  AA07  COMMA?
  AA09  YES, DONE >>AA37
  AA0B  BLANK?
  AA0D  YES, DONE >>AA37
  AA0F  RETURN?
  AA11  YES, OUT NOW >>AA48
  AA13  PATHNAME TOO LONG? (BCAA)
  AA16  NO, CONTINUE COPYING >>AA00
  AA18  ELSE, SET NOT-EQUAL CONDITION
  AA1A  AND EXIT

AA1B ********** COPY COMMAND NAME INTO TXTBUF ***********************

  AA1B  SET INDICIES
  AA1F  GET NEXT NON-BLANK <AA4A>
  AA22  COPY TO TXTBUF (BCBD)
  AA26  COMMA?
  AA28  YES, DONE >>AA37
  AA2A  BLANK?
  AA2C  YES, DONE >>AA37
  AA2E  RETURN?
  AA30  YES, DONE >>AA48
  AA32  AT MAX LENGTH (8)? (BCAA)
  AA35  NO, CONTINUE >>AA1F
  AA37  ELSE, SET NOT-EQUAL CONDITION
  AA39  AND EXIT
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AA39
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

AA3A ********** FLUSH TO NON-BLANK **********************************
          Z-FLAG SET IF COMMA OR RETURN FOUND
          C-FLAG SET IF COMMA

  AA3A  IGNORE BLANKS
  AA3F  GET NEXT NON-BLANK <AA4A>
  AA42  COMMA?
  AA44  YES, OUT >>AA49
  AA46  RETURN?
  AA48  EXIT INDICATING WHAT WE FOUND
  AA49  RETURN

AA4A ********** GET NEXT CHARACTER **********************************

  AA4A  GET NEXT CHAR IN INPUT LINE (0200)
  AA4D  FORCE OFF MSB
  AA4F  LOWER CASE?
  AA51  NO >>AA55
  AA53  YES, FORCE UPPER CASE
  AA55  BUMP LINE INDEX
  AA56  IS THIS A FLUSH CHARACTER (LIKE BLANK)? (BCA9)
  AA59  YES, GO GET NEXT ONE >>AA4A
  AA5B  ELSE, RETURN WITH IT

AA5C ********** CONVERT DIGIT AND ADD TO ACCUM **********************

  AA5C  NUMERIC?
  AA5E  NO >>AA64
  AA62  YES >>AA68
  AA64  NOT NUMERIC, EXIT WITH CARRY SET
  AA65  AND Z-FLAG RESET
  AA67  RETURN
  AA68  ISOLATE DECIMAL PORTION OF DIGIT
  AA6B  CURRENT VALUE OF ACCUM... (BCB1)
  AA6E  >1,703,936?
  AA70  YES, OVERFLOW >>AA94
  AA74  PUSH ENTIRE ACCUM ONTO STACK (BCAF)
  AA7B  ACCUM*2 (ROL IT ONCE) <AAD7>
  AA7E  ACCUM*4 (AND AGAIN) <AAD7>
  AA84  ---
  AA85  ACCUM*4+ACCUM --> ACCUM*5 (BCAF)
  AA91  FINALLY, ACCUM*5*2 --> ACCUM*10 <AAD7>
  AA94  ---
  AA95  ACCUM OVERFLOW? >>AAAA
  AA97  NO, ADD NEW DIGIT TO ACCUM (BCAF)
  AA9A  AND STORE IT (BCAF)
  AA9D  NO CARRY? >>AAAD
  AAA0  GOT CARRY, PROPAGATE IT THRU ACCUM (BCB0)
  AAAA  OVERFLOW ERROR
  AAAD   NORMAL EXIT
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AAAD
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

AAAE ********** CONVERT HEX DIGIT AND ADD ***************************

  AAAE  NUMERIC?
  AAB0  NO >>AABE
  AAB4  YES >>AAC4
  AAB6  NON-NUMERIC, HOW BOUT "A" THRU
  AABA  "F"
  AABC  YES! >>AAC2
  AABE  ---
  AABF  NO, GET OUT NOW
  AAC1  RETURN
  AAC2  "A" THRU "F", CONVERT TO $BA-$BF
  AAC4  ISOLATE DIGIT
  AAC8  SHIFT ACCUM 4 BITS LEFT TO MAKE ROOM <AAD7>
  AACB  (WATCH OUT FOR OVERFLOW) >>AAAA
  AAD0  OR IN NEW NIBBLE (BCAF)
  AAD3  AND REPLACE IN ACCUM LSB (BCAF)
  AAD6  DONE

AAD7 ********** SHIFT 3 BYTE ACCUM LEFT A BIT ***********************

  AAD7  SHIFT THE THREE BYTE WORK ACCUM (BCAF)
  AAE0  RETURN

AAE1 ********** SCAN CMD TABLE FOR COMMAND ***************************

  AAE1  START WITH LAST COMMAND IN TABLE
  AAE6  IS IT A "-" COMMAND? (BCBD)
  AAEB  NOPE >>AAF5
  AAED  YES, SPECIAL COMMAND NUMBER (BE53)
  AAF0  ZERO LENGTH COMMAND STRING (BE52)
  AAF3  CONTINUE >>AB12
  AAF5  FIRST COMMANDS IN TABLE ARE 8 CHARS
  AAFA  GET INDEX TO NEXT NAME (B858)
  AAFD  SAME LENGTH AS LAST NAME? >>AB05
  AAFF  NO,
  AB02  NAMES ARE ONE BYTE SHORTER FROM NOW ON (BE52)
  AB05  ---
  AB06  COMPARE HIS NAME TO MY TABLE (BCBD)
  AB0C  NOT IT... >>AB25
  AB10  COMPARE ENTIRE NAME >>AB06

  AB12  FOUND IT! GET COMMAND INDEX (BE53)
  AB15  *2 FOR MOST THINGS
  AB17  PICK UP PERMITTED PARMS BITS (B92A)
  AB23  EXIT HAPPILY
  AB24  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AB24
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  AB25  NOT THE ONE, SKIP TO NEXT (BE52)
  AB2E  IF THERE ARE ANY MORE >>AAFA
  AB30  ELSE, NO SUCH COMMAND (BE53)
  AB34  XRETURN THRU $BE06 VECTOR >>BE06

AB37 *********** ZERO THREE BYTE ACCUM *****************************

  AB37  ZERO THE THREE BYTE WORK
  AB39  ...ACCUMULATOR (BCAF)
  AB42  RETURN

AB43 *********** "-" COMMAND ***************************************

  AB43  CHECK FILE TYPE (BEB8)
  AB46  APPLESOFT PROGRAM?
  AB48  YES, "RUN" IT >>ABB2
  AB4A  BINARY FILE?
  AB4C  YES, "BRUN" IT >>AB8D
  AB4E  TEXT FILE?
  AB50  NO >>AB55
  AB52  YES, "EXEC" IT >>B221
  AB55  SYS FILE?
  AB57  YES, GO RUN IT >>AB5D
  AB59  ELSE, "FILE TYPE MISMATCH"
  AB5C  RETURN

        ******** RUN "SYS" FILE *****************

  AB5D  CLOSE ALL OPEN FILES <B4F2>
  AB60  CLOSE EXEC <B2FB>
  AB65  LSB OF A$ IS 00 (BE58)
  AB68  FREE UP ALL OF BI'S MEMORY (BF6B)
  AB7B  A$2000 IS WHERE IT WILL LOAD (BE59)
  AB80  TYPE IS "SYS" (BE6A)
  AB8A  FORCE, T, PATHNAME1, AD PARMS (BE56)
  AB8D  GO DO A STANDARD BRUN >>AE16

AB90 *********** "CHAIN" COMMAND ************************************

  AB90  SQUASH VARIABLES UP AGAINST HIMEM  <A40D>
  AB95  SAVE HIMEM (BC7B)
  AB9C  SET NEW HIMEM BELOW COMBINED VARS
  AB9E  LOAD FILE (LEAVE OTHERS OPEN) <AC03>
  ABA4  RESTORE OLD HIMEM
  ABA6  ERROR? >>AC14
  ABA8  NO, CLEAR VARIABLES <D665>
  ABAB  REEXPAND VARIABLES DOWN AGAINST LOMEM <A472>
  ABB0  THEN GO "RUN" PROGRAM >>ABC7
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: ABB0
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

ABB2 *********** "RUN" COMMAND ***************************************

  ABB2  NO INPUT FILE ACTIVE NOW
  ABB7  NO APPLESOFT ERROR NUMBER
  ABBC  GOT PATHNAME1?
  ABBD  NO, ERROR >>ABD5
  ABBF  YES, LOAD PROGRAM <ABFE>
  ABC2  ERROR? >>AC14
  ABC4  NO, CLEAR VARIABLES <D665>

  ABC7  CLEAR ERROR FLAG
  ABC9  POSITION TO LINE NUMBER IF GIVEN <AC97>
  ABCC  RESTORE MY INTERCEPTS <9A8D>
  ABCF  CLEAR COMMAND NUMBER ETC., MODE = 4 <ABD5>
  ABD2  JUMP INTO APPLESOFT TO RUN PROGRAM >>D7D2

ABD5 *********** CLEAR COMMAND NUMBER ETC. ***************************

  ABD5  SET NORMAL (NON-INVERSE OR FLASH) <F273>
  ABDA  SEARCH CHARACTER FOR TRACE IS "#" (9F61)
  ABDF  NO COMMAND NUMBER NOW (BE53)
  ABE2  NO PROMPT
  ABE6  SET MODE=4 (DEFERRED) <9F76>
  ABE9  "SYNTAX ERROR" IF THINGS GO WRONG >>A839

ABEC *********** "LOAD" COMMAND ***************************************

  ABEC  LOAD PROGRAM <ABFE>
  ABEF  ERROR? IF NOT, FALL THRU TO WARMSTART >>AC14

ABF1 *********** WARMDOS: WARMSTART BI ******************************

  ABF1  CLEAR APPLESOFT, RESET POINTERS <D665>
  ABF4  RESET MODE/SET INTERCEPTS <9A17>
  ABF9  CURSOR HORIZ. = 0 (START OF LINE)
  ABFB  GO WARMSTART APPLESOFT >>D43F

ABFE *********** LOAD A PROGRAM ***************************************

  ABFE  CLOSE ALL OPEN FILES  <B4F2>
  AC01  ERROR? >>AC14
  AC03  GO LOAD FILE <AC15>
  AC06  ERROR? >>AC14
  AC08  SET LOMEM = ARRAYS = FREESTART
  AC0A  ALL TO END OF PROGRAM LOADED
  AC14  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AC14
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

AC15 *********** READ A PROGRAM FROM A FILE ***************************

  AC15  READ REQUESTED
  AC17  TYPE = BAS ASSUMED
  AC19  OPEN THE FILE <B194>
  AC1C  ERROR? >>AC14
  AC20  MLI: GET EOF <BE70>
  AC23  ERROR? >>AC14
  AC27  APPLESOFT PROGRAM START --> READ DATA (BED7)
  AC2A  ADD TO THAT THE EOF MARK TO ... (BEC8)
  AC2D  SET AD PARM --> END OF PROGRAM IMAGE (BE58)
  AC3B  OVERFLOW? >>AC3F
  AC3D  NO, WOULD PROGRAM EXCEED HIMEM?
  AC3F  IF SO...
  AC41  "PROGRAM TOO LARGE" >>AC14
  AC43  ELSE, PICK UP LENGTH AGAIN (BEC8)
  AC49  AND GO READ IT IN <AF98>
  AC4C  ERROR? >>AC14
  AC4E  CLOSE FILE <AF94>
  AC51  ERROR? >>AC14
  AC53  RELOCATE PROGRAM IF NECESSARY <AC61>
  AC5C  COPY AD PARM TO APPLESOFT PGM END PTR
  AC60  RETURN

AC61 *********** RELOCATE APPLESOFT PROGRAM ***************************

  AC61  ---
  AC62  WAS APPLESOFT PROGRAM SAVED FROM SAME
  AC64  MEMORY LOCATION? (BEB9)
  AC73  YES, NOTHING TO DO THEN >>ACBA
  AC79  ELSE, LOOP THROUGH PROGRAM
  AC7B  ADJUSTING ALL ADDRESSES TO
  AC7D  THE NEW LOAD LOCATION

AC97 *********** POSITION TO LINE NUMBER ******************************

  AC97  WAS A LINE NUMBER PARM GIVEN? (BE57)
  AC9D  NO, NEVER MIND >>ACBA
  AC9F  COPY L KEYWORD VALUE TO APPLESOFT'S LINE # (BE68)
  ACA9  THEN CALL APPLESOFT TO FIND THE LINE <D61A>
  ACAF  SUBTRACT ONE FROM THE ADDRESS
  ACB1  AND POINT APPLESOFT'S GETCHR SUBROUTINE
  ACB3  AT IT (SO NEXT CHAR READ WILL BE FIRST
  ACB5  CHARACTER ON THE LINE).
  ACBA  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: ACBA
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

ACBB *********** "SAVE" COMMAND ***************************************

  ACBB  DOES FILE EXIST ALREADY? >>ACDF
  ACBD  NO, TYPE = BAS
  ACBF  IN T KEYWORD VALUE (BE6A)
  ACC2  AND MLI LIST (BEB8)
  ACC7  ALLOW ALL ACCESSES (READ/WRITE/ETC.) (BEB7)
  ACCC  SAVE PROGRAM START ADDRESS IN (BEA5)
  ACCF  AUXID'S (BEB9)
  ACDA  GO CREATE A NEW FILE <AD46>
  ACDD  ERROR? >>AD28

  ACDF  WRITE ACCESS REQUESTED
  ACE1  BAS TYPE FILE
  ACE3  OPEN IT <B194>
  ACE6  ERROR? >>AD28
  ACEB  SUBTRACT APPLESOFT PTRS TO COMPUTE
  ACED  LENGTH OF PROGRAM.
  ACEE  STORE THIS IN EOF MARK LIST (BEC8)
  ACFB  MSB OF EOF MARK IS 00 (<64K PGM) (BECA)
  AD00  POINT LIST TO PROGRAM AS DATA TO WRITE (BED7)
  AD08  WRITE A RANGE TO DISK FILE <AF9C>
  AD0B  ERROR? >>AD28
  AD0F  MLI: SET EOF (TO TRUNCATE OLD LONGER FILE) <BE70>
  AD12  ERROR? >>AD28
  AD14  CLOSE THE FILE <AF94>
  AD17  ERROR? >>AD28
  AD1B  DOES PROGRAM START MATCH AUXID IN FILE INFO?
  AD20  NO, CHANGE IT >>AD29
  AD28  ELSE, EXIT

  AD29  TO CHANGE IT, (BEB9)
  AD2F  EXIT THRU SET FILE INFO ROUTINE >>B7D9

AD32 *********** "CREATE" COMMAND *************************************

  AD32  AUXID = 0 (A$ OR RECLN)
  AD3D  TYPE KEYWORD GIVEN?
  AD3F  YES >>AD46
  AD43  NO, ASSUME TYPE = DIR (BE6A)

  AD46  *** CREATE FILE ENTRY *** (BE43)
  AD49  EXEC FILE ACTIVE?
  AD4C  HOW MANY FILES ARE OPEN INCLUDING EXEC? (BE4D)
  AD4F  8 OR MORE?
  AD51  YES, ERROR >>AD6E
  AD56  ELSE, SET TYPE IN MLI LIST (BEA4)
  AD59  FULL ACCESS (READ/WRITE/ETC.)
  AD5B  KIND = STANDARD FILE
  AD5D  DIR FILE WANTED?
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AD5F
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  AD5F  NO >>AD63
  AD61  YES, KIND = DIR FILE
  AD63  SET ACCESS (BEA3)
  AD66  AND KIND  (BEA7)
  AD6B  MLI: CREATE (DON'T COME BACK HERE) >>BE7Ø

  AD6E  "RAM TOO LARGE" ERROR
  AD7Ø  RETURN

AD71 *********** "RENAME" COMMAND ***********************************

  AD71  ---
  AD75  SECOND PATHNAME GIVEN?
  AD78  IF SO, GO MLI: RENAME >>AD7F
  AD7A  "SYNTAX ERROR" OTHERWISE >>A839

AD7D *********** "DELETE" COMMAND ***********************************

  AD7D  SETUP MLI: DELETE CALL TYPE
  AD7F  EXIT THRU MLI CALL >>BE7Ø

AD82 *********** "LOCK" COMMAND *************************************

  AD82  GET FILE INFO FOR PATHNAME1 <B7DØ>
  AD85  GET ACCESS CODES (BEB7)
  AD88  TURN OFF ALL...
  AD8A  BUT READ
  AD8F  THEN GO SET UPDATED FILE INFO >>B7E7

AD92 *********** "UNLOCK" COMMAND ***********************************

  AD92  GET FILE INFO FOR PATHNAME1 <B7DØ>
  AD95  TURN ON ALL FILE ACCESSES
  AD9D  THEN GO SET UPDATED FILE INFO >>B7E7

ADAØ *********** "PREFIX" COMMAND ************************************

  ADAØ  SLOT/DRIVE GIVEN ON COMMAND? (BE57)
  ADA6  IF SO, GOT OPERAND ALREADY >>ADAC
  ADA8  ELSE, (BE56)
  ADAB  CHECK FOR PATHNAME1
  ADAC  AND GO DO MLI: SET PREFIX ...
  ADAE  IF IT'S THERE >>AD7F
  ADBØ  ELSE, IS BASIC PROGRAM RUNNING?
  ADB2  IF SO, SET PREFIX ACTIVE FLAG >>ADD1
  ADB4  NO, NEW LINE <9FAB>
  ADBC  END OF NAME YET? >>ADC9
  ADBE  NO, COPY NAME IN PATHNAME1 BUFFER (BCBD)
  ADC3  TO OUTPUT DEVICE <9FAD>
  ADC9  AND SKIP A BLANK LINE <9FAB>
  ADDØ  DONE
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: ADDØ
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  ADD1  SET PREFIX ACTIVE FLAG
  ADD3  SO BASIC CAN READ THE PREFIX (BE46)
  ADD7  RETURN

ADD8 *********** "BSAVE" COMMAND ************************************

  ADD8  PATHNAME1 FOUND? >>AEØE
  ADDA  NO, NEW FILE (BE57)
  ADDD  AD, L, AND E POSSIBLE
  ADDF  AD AND EITHER L OR E REQUIRED
  ADE1  OR ELSE ERROR >>AE12
  ADE6  PUT AD IN CREATE PARAMETER LIST (BEA5)
  ADE9  AND IN GET FILE INFO LIST (BEB9)
  ADF7  TYPE = BIN ASSUMED (BE6A)
  AEØØ  T KEYWORD GIVEN?
  AEØ2  IF SO, ERROR >>AE12
  AEØ4  GO CREATE THE FILE <AD46>
  AEØ7  ERROR? >>AE14
  AEØ9  GET FILE INFO <B7DØ>
  AEØC  ERROR? >>AE14
  AEØE  WRITING...
  AE1Ø  GO PROCESS LIKE A BLOAD OTHERWISE >>AE25

  AE12  "PATH NOT FOUND" ERROR
  AE14  ---
  AE15  RETURN

AE16 *********** "BRUN" COMMAND *************************************
          (DOES NOT SET MODE=4 SO DOS COMMANDS MAY
          NOT BE ISSUED AS WITH A BASIC PROGRAM)

  AE16  BLOAD IT FIRST <AE23>
  AE19  ERROR? >>AE14
  AE1B  THEN CALL IT <AE2Ø>
  AE1E  THEN EXIT
  AE1F  RETURN
  AE2Ø  INDIRECT JMP TO BINARY PROGRAM >>BED7

AE23 *********** "BLOAD" COMMAND ************************************

  AE23  READING...
  AE25  TYPE = BIN
  AE27  OPEN THE FILE <B194>
  AE2A  ERROR? >>AE14
  AE2C  ASSUME USER SPECIFIED AD KEYWORD (BE58)
  AE35  IF SO, USE HIS ADDRESS >>AE47
  AE37  ELSE, USE AD IN FILE INFO AUXID  (BEB9)
  AE4Ø  WAS T KEYWORD GIVEN?
  AE42  YES, INVALID PARM (ONLY BIN IS LEGAL) >>AE78
  AE47  POINT READ/WRITE PARMS TO DATA (BED7)
```

```
BASIC Interpreter (BI) -- V1.1 --1B JUN B4      NEXT OBJECT ADDR: AE4D
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

 AE4D  PICK UP LENGTH FROM L KEYWORD VALUE (BE5F)
 AE53  WAS L OR E GIVEN?
 AE55  NEITHER >>AE7C
 AE57  BOTH?
 AE59  YES...NAUGHTY! >>AE7B
 AE5B  E GIVEN?
 AE5D  NO, MUST BE L >>AE92
 AE5F  YES... (BE5D)
 AE63  COMPUTE L = (E - AD) (BE58)
 AE6F  PLUS ONE FOR INCLUSIVE RANGE >>AE72
 AE72  MAKE SURE NO BORROW OCCURED >>AE92

 AE74  OR ELSE, "RANGE ERROR"
 AE77  RETURN

 AE7B  "INVALID PARM" ERROR
 AE7B  RETURN

 AE7C  ---
 AE7E  MLI: GET EOF <BE70>
 AEB1  ERROR? >>AE90
 AEB3  GET L (EOF MARK) (BEC8)
 AEB9  BETTER NOT EXCEED 64K (BECA)
 AEBC  NO.. >>AE92

 AEBE  YES, "PROGRAM TOO LARGE"
 AE90  ---
 AE91  RETURN

 AE92  STORE LENGTH TO READ OR WRITE (BED9)
 AE9B  B KEYWORD GIVEN?
 AE9D  NO >>AEC4
 AEA1  YES, COPY B VALUE TO SET MARK LIST (BE5A)
 AEAA  ---
 AEAC  MLI: SET MARK <BE70>
 AEB2  NO ERROR? >>AEC4
 AEB4  ERROR, RANGE ERROR?
 AEB6  NO >>AE90
 AEB8  BSAVING (NOT BLOAD/BRUNING)?
 AEBA  NO >>AE90
 AEBE  MLI: FORCE EOF FORWARD TO MARK <BE70>
 AEC1  AND TRY SET MARK AGAIN >>AEAA
 AEC3  RETURN
 AEC4  GET COMMAND NUMBER (BE53)
 AEC7  ASSUME READ
 AEC9  BSAVE?
 AECB  NO, READ IS CORRECT >>AECF
 AECD  WRITING
 AECF  MLI: READ OR WRITE <BE70>
 AED2  ERROR? >>AE90
 AED4  THEN EXIT THRU CLOSE >>AF94
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AED4
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

AED7 *********** "STORE" COMMAND ************************************

 AED7  PATHNAME1 EXISTS? >>AEEB
 AED9  NO, T = VAR BY DEFAULT
 AEE1  FULL ACCESS (READ/WRITE/ETC.)
 AEE6  CREATE THE FILE <AD46>
 AEE9  ERROR? >>AF39
 AEEB  COMPRESS APPLESOFT VARS AGAINST HIMEM <A40D>
 AEF4  OPEN "VAR" FILE FOR WRITE <B194>
 AEF7  ERROR? >>AF32
 AEF9  POINT TO INTERNAL 5 BYTE HEADER BUFFER <AF3A>
 AEFC  AND WRITE OUT LENGTHS OF VARS <AF9C>
 AEFF  ERROR? >>AF32
 AF01  STORE ADDRESS OF VARS (BCBE)
 AF04  IN READ/WRITE PARM LIST (BED7)
 AF07  AND FILE INFO AUXID (BEB9)
 AF13  GET LENGTH OF VARS (BC91)
 AF19  AND WRITE THEM OUT <AF9C>
 AF1C  ERROR? >>AF32
 AF20  MLI: GET MARK <BE70>
 AF25  MLI: SET NEW EOF (TRUNCATE IF NECESSARY) <BE70>
 AF28  ERROR? >>AF32
 AF2A  SET FILE INFO WITH AD OF VARS <B7D9>
 AF2D  ERROR? >>AF32
 AF2F  CLOSE FILE <AF94>
 AF32  ---
 AF34  REEXPAND VARS BACK AGAIN <A472>
 AF39  RETURN

AF3A *********** SETUP TO READ/WRITE VAR HDR ************************
          APPLESOFT VARIABLES HEADER CONSISTS OF:
          2 BYTE LENGTH OF SIMPLE+ARRAY VARIABLES
          2 BYTE LENGTH OF SIMPLE VARIABLES ONLY
          1 BYTE MSB OF HIMEM FOR THESE VARIABLES

 AF3A  STORE ADDRESS OF 5 BYTE INFO
 AF3C  IN READ/WRITE PARM LIST (BED7)
 AF46  LENGTH = 5
 AF48  RETURN

AF49 *********** "RESTORE" COMMAND *********************************

 AF49  TYPE = VAR
 AF4B  READING
 AF4D  OPEN THE FILE <B194>
 AF50  ERROR? >>AF39
 AF52  SET UP TO READ THE HEADER <AF3A>
 AF55  READ 5 BYTE HEADER <AF98>
 AF58  ERROR? >>AF39
 AF5A  PICK UP WHERE TO READ IN COMPRESSED VARS (BEB9)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AF5D
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  AF5D  FROM AUXID (BC8E)
  AF63  ADJUST MSB OF THIS BY THE DIFFERENCE
  AF66  BETWEEN HIMEM'S (NOW AND WHEN STORED) (BC8D)
  AF73  MAKE SURE VARS WON'T OVERLAY PROGRAM
  AF75  IF SO, ERROR >>AF90
  AF7F  COMPUTE LENGTH OF ALL VARS/STRINGS
  AF81  (HIMEM-START) (BC8F)
  AF85  GO READ COMBINED VARS INTO MEMORY <AF98>
  AF88  ERROR? >>AF39
  AF8A  CLOSE THE FILE <AF94>
  AF8D  EXIT BY REEXPANDING THE VARS DOWN >>AF32

  AF90  "PROGRAM TOO LARGE" ERROR
  AF93  RETURN

AF94 *********** CLOSE FILE ***************************************

  AF94  SET MLI CLOSE OPCODE
  AF96  AND GO TO MLI >>AFA4

AF98 *********** READ/WRITE A RANGE *********************************

  AF98  READ MLI OPCODE
  AF9A  JUMP IN >>AF9E
  AF9C  WRITE MLI OPCODE
  AF9E  STORE LENGTH (BEDA)
  AFA4  EXIT THRU MLI:READ OR WRITE >>BE70

AFA7 *********** "PR#" COMMAND ***************************************

  AFA7  USE CSWL AND OUTVEC
  AFAC  JUMP TO COMMON CODE >>AFB5

AFAE *********** "IN#" COMMAND ***************************************

  AFAE  USE KSWL
  AFB3  AND INVEC

  AFB5  OR IN SLOT GIVEN BY USER (BE6B)
  AFB8  *2 FOR USE AS INDEX INTO TABLE
  AFBD  WAS SLOT PARAMETER GIVEN?
  AFBF  NO... >>AFD2
  AFC1  YES, (BE57)
  AFC4  AD GIVEN? >>AFE7
  AFC6  NO, GET INVEC OR OUTVEC FOR THIS SLOT (BE10)
  AFC9  AND STORE ON AD KEYWORD VALUE (BE58)
  AFD2  VALIDITY CHECK I/O DRIVER <AFF9>
  AFD5  NO GOOD? >>AFE6
  AFD7  GET INDEX TO CSWL OR KSWL (BCA9)
  AFDD  AND REPLACE ONE OR THE OTHER WITH (0036)
  AFE0  HIS ADDRESS (BE59)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: AFE6
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  AFE6  RETURN

  AFE7  VALIDITY CHECK AD KEYWORD VALUE <AFF9>
  AFEA  NO GOOD? >>AFF8
  AFEC  GOOD, COPY VALUE TO INVEC OR OUTVEC (BE59)
  AFF8  EXIT BUT DON'T REDIRECT I/O NOW

AFF9 *********** VALIDITY CHECK I/O DRIVER ***************************

  AFF9  $3A/3B --> NEW HANDLER (FROM AD PARM) (BE58)
  B005  IS DRIVER IN MAIN RAM (BELOW $C000)?
  B007  YES >>B01E
  B009  NO, RESET I/O CARD ROMS (CFFF)
  B00C  USE $3C TO COUNT ITERATIONS
  B00E  TEST ROM AT USER'S ADDRESS
  B014  FOR STABILITY
  B018  256 TIMES
  B01C  MUST BE OK
  B01D  RETURN
  B01E  MAIN RAM I/O DRIVER
  B020  MUST START WITH A "CLD" INSTRUCTION
  B022  OK... >>B01C

  B024  ELSE, "NO DEVICE CONNECTED"
  B027  RETURN

B028 *********** "BYE" COMMAND ***************************************

  B028  CLOSE ANY OPEN FILES <B4F2>
  B02B  CLOSE EXEC FILE, IF ANY <B2FB>
  B030  MLI CALL: <BF00>
  B033  QUIT
  B034  USE READ PARMLIST BECAUSE QUIT DOESN'T NEED PARMS.

B036 *********** "CAT" COMMAND ***************************************

  B036  39 CHARACTERS PER LINE
  B038  THEN PROCESS LIKE "CATALOG" >>B03C

B03A *********** "CATALOG" COMMAND ***********************************

  B03A  79 CHARACTERS PER LINE
  B03C  STORE LINE LENGTH (BCB6)
  B042  TEST FOR T AND
  B044  ....PATHNAME1 GIVEN
  B045  GOT T >>B04A
  B047  NO T, T=0 (ANY TYPE WILL DO) (BE6A)
  B04A  GOT PATHNAME1 >>B051
  B04C  NO PATHNAME1, GET FILE INFO FOR PREFIX <B7D0>
  B04F  ERROR? >>B0B7
  B051  OPEN/READ DIRECTORY HEADER <B14A>
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B054
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B054  ERROR? >>B0B7
  B056  SKIP TO A NEW LINE <9FAB>
  B059  FORMAT DIRECTORY'S NAME TO $201 <B0B8>
  B05C  PRINT $201 <9F9D>
  B05F  SKIP TO A NEW LINE <9FAB>
  B062  BLANK $201 BUFFER <A66C>
  B067  UNPACK HEADING MESSAGE LINE <9FB0>
  B06A  PRINT IT (40 OR 80 COLUMNS) <9F9D>
  B06D  SKIP TO A NEW LINE <9FAB>
  B073  ANY FILES IN THIS DIRECTORY? (BCBA)
  B076  NO  >>B0A3
  B078  YES, READ NEXT ENTRY <B1D1>
  B07B  ERROR? >>B0B7
  B07D  GET TYPE REQUESTED FOR SEARCH (BE6A)
  B080  ANY TYPE WILL DO? >>B087
  B082  NO, CHECK TYPE AGAINST THIS ENTRY (0269)
  B085  NOT IT, SKIP IT >>B08D
  B087  ELSE, FORMAT ENTRY TO $201 <A4C4>
  B08A  AND PRINT $201 <9F9D>
  B08D  CHECK KEYBOARD (C000)
  B090  FOR A CONTROL-C
  B092  IGNORE ANYTHING ELSE >>B09E

  B094  CONTROL-C, WHAT STATE ARE WE IN? (BE42)
  B097  DEFERRED >>B0A3
  B099  NO, IMMEDIATE, RESET KEYBOARD STROBE (C010)
  B09C  AND EXIT RIGHT NOW >>B0A3

  B09E  ELSE, ANY FILES LEFT IN COUNT? (BCBA)
  B0A1  YES, CONTINUE >>B078
  B0A3  ELSE, CLOSE DIRECTORY <AF94>
  B0A6  ERROR? >>B0B7
  B0A8  SKIP TO A NEW LINE <9FAB>
  B0AB  FORMAT BLOCKS FREE AND IN USE TO $201 <B0E7>
  B0AE  ERROR? >>B0B7
  B0B0  PRINT $201 <9F9D>
  B0B3  SKIP A LINE <9FAB>
  B0B7  DONE

B0B8 *********** FORMAT NAME OF DIRECTORY ****************************

  B0B8  BLANK $201 BUFFER <A66C>
  B0BB  FILE NAME IS AT +1 INTO DIR ENTRY
  B0BD  GET NAME LENGTH/TYPE (025D)
  B0C2  VOLUME DIRECTORY HEADER?
  B0C4  NO >>B0CA
  B0C6  YES, START NAME WITH "/" (0200)
  B0CA  ---
  B0CB  ISOLATE NAME LENGTH FROM TYPE
  B0CD  AND SET UP LENGTH TO COPY (0200)
  B0D2  COPY DIRECTORY NAME TO (0259)
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B0D7
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B0D7  ...LINE (0200)
  B0E1  SET $200 TO MAXIMUM LENGTH
  B0E6  RETURN

B0E7 *********** FORMAT BLOCKS FREE/INUSE ****************************

  B0E7  POINT MLI:ONLINE PARMLIST
  B0E9  TO TXTBUF (PATHNAME1) (BEC8)
  B0F1  COPY DEVICE NUMBER (UNIT) (BF30)
  B0F9  MLI: ONLINE <BE70>
  B0FC  ERROR? >>B0B7
  B101  ISOLATE NAME LENGTH FROM BUFFER
  B104  BUMP BY ONE TO INCLUDE "/"
  B105  AND STORE IT AS A PREFIX (BCBC)
  B10A  STORE "/" AS FIRST CHARACTER (BCBD)
  B10D  GET FILE INFO FOR PREFIX <B7D0>
  B110  ERROR? >>B0B7
  B112  BLANK $201 BUFFER <A66C>
  B117  UNPACK "BLOCKS FREE: BLOCKS USED.." <9FB0>
  B11A  ZERO THE THREE BYTE ACCUM <AB37>
  B125  CONVERT AUXID (TOTAL BLOCKS) <A62F>
  B130  CONVERT BLOCKS USED <A62F>
  B137  BLOCKS_FREE = TOTAL_BLOCKS (BEBC)
  B13E  ... - BLOCKS_USED (BEBD)
  B145  CONVERT BLOCKS FREE <A62F>
  B149  DONE!

B14A *********** OPEN/READ DIRECTORY HDR ****************************

  B14A  READ ONLY
  B14E  CHECK FILE KIND (BEBB)
  B151  VOLUME DIRECTORY?
  B153  NO >>B158
  B155  YES, TYPE = DIR (BEB8)
  B158  OPEN THE FILE <B1A0>
  B15B  ERROR? IF NOT, FALL THRU >>B193

B15D *********** READ DIRECTORY HDR *********************************

  B15D  BUFFER IS $259
  B169  LENGTH IS $2B (ONE ENTRY) (BED9)
  B173  MLI: READ <BE70>
  B176  ERROR? >>B193
  B17A  COPY ENTRY LENGTH, ENTRIES PER BLOCK, (027C)
  B17D  AND FILE COUNT FROM DIR HDR (BCB7)
  B183  STORE ENTRY LENGTH IN READ LENGTH NOW (BED9)
  B188  SET COUNTER TO FIRST ENTRY IN BLOCK (BCBB)
  B18D  MARK = 0 (START OF FILE) (BEC9)
  B193  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B193
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

B194 *********** OPEN FILE ***********************************************
          A REGISTER = ACCESS BITS
          X REGISTER = DEFAULT TYPE

  B194  ---
  B198  T KEYWORD GIVEN?
  B19A  NO >>B19F
  B19C  YES, USE KEYWORD VALUE INSTEAD (BE6A)
  B19F  ---
  B1A0  EXISTING FILE OF THIS TYPE? (BEB8)
  B1A3  NO, ERROR >>B1C9
  B1A5  CHECK ACCESS REQUESTED (BEB7)
  B1A8  REQUESTED ACCESS NOT PERMITTED >>B1CD
  B1AA  SET SYSTEM BUFFER IN OPEN PARM LIST (BC88)
  B1B2  LEVEL = $0F (BF94)
  B1B7  MLI: OPEN <BE70>
  B1BA  ERROR? >>B1C8
  B1BF  SAVE REFNUM IN READ/WRITE PARMLIST (BED6)
  B1C2  AND CLOSE PARMLIST (BEDE)
  B1C5  AND GET/SET EOF/MARK LIST (BEC7)
  B1C8  AND EXIT

  B1C9  "FILE TYPE MISMATCH"
  B1CC  RETURN
  B1CD  "FILE LOCKED"
  B1D0  RETURN

B1D1 *********** READ NEXT DIRECTORY ENTRY ***************************

  B1D1  FORCE MARK TO START OF THIS BLOCK (BEC9)
  B1D9  CHECK ENTRY NUMBER (BCBB)
  B1DE  LAST ENTRY IN THIS BLOCK? (BCB8)
  B1E1  NO >>B1ED
  B1E4  YES, ENTRY 0 NEXT TIME (BCBB)
  B1E7  BUMP MARK TO NEXT BLOCK (BEC9)
  B1ED  ---
  B1EF  MARK POSITIONED TO PROPER ENTRY YET? >>B1F8
  B1F1  NO, BUMP POINTER TO NEXT ENTRY (BCB7)
  B1F4  AND CONTINUE IF STILL FIRST PAGE >>B1ED
  B1F6  JUST ENTERED SECOND PAGE >>B1EA
  B1F8  ADD 4 TO PTR TO ADJUST FOR BLOCK PREFIX
  B1FF  MLI: SET MARK <BE70>
  B202  ERROR? >>B21D
  B206  MLI: READ <BE70>
  B209  ERROR? >>B21D
  B20B  BUMP ENTRY COUNTER (BCBB)
  B211  IS THIS ENTRY VALID?
  B213  NO, SKIP OVER IT >>B1D1
  B215  DECREMENT FILE COUNT (BCB9)
  B21D  AND RETURN TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B21D
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

B21E *********** EXTERNAL COMMAND HANDLER ****************************

  B21E  INDIRECT JMP TO XTRNAD VECTOR >>BE50

B221 *********** "EXEC" COMMAND ***************************************

  B221  IS THIS FILE OPEN ALREADY? <B41F>
  B224  NO >>B250
  B226  YES, EXEC CLOSING? (BE4E)
  B229  NO >>B24C
  B22B  SAVE REFNUM (BEC7)
  B230  RESET MARK TO ZERO (BEC8)
  B23B  MLI: SET MARK <BE70>
  B23E  ERROR? >>B245
  B240  GET REFNUM AGAIN (BEC7)
  B243  GO RESTART THIS EXEC FILE FROM ITS START >>B2C3

        ******** CLOSE EXEC FILE ****************

  B245  PRESERVE CALLER'S AREG
  B246  AND CLOSE THE FILE <B2FB>
  B24B  THEN RETURN WITH ERROR

  B24C  "FILE BUSY" ERROR
  B24F  RETURN

        ******** CONTINUE EXEC SETUP ************

  B250  EXEC ACTIVE? (BE43)
  B253  NO >>B25A
  B255  YES, CLOSE IT <B2FB>
  B258  ERROR? >>B263
  B25A  GET FILE TYPE (BEB8)
  B25D  SHOULD BE TXT
  B25F  IT IS >>B265

  B261  ELSE, "FILE TYPE MISMATCH"
  B263  RETURN WITH ERROR
  B264  RETURN

  B265  MOVE STRINGS TO MAKE ROOM FOR A BUFFER <A1F5>
  B268  NO ROOM? >>B263
  B26C  STORE NEW BUFFER ADDRESS IN PARM LIST (BEC8)
  B275  GET COUNT OF OPEN FILES (BE4D)
  B278  NO OTHERS CURRENTLY OPEN? >>B29E
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B278
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

        ******** MAKE EXEC TOPMOST BUFFER *******

  B27A  OTHERS ARE OPEN...
  B27C  OPENCOUNT*4 (4 PAGES PER BUFFER)
  B27E  ADD THIS TO MY BUFFER TO FIND TOP BUFFER (BC88)
  B282  SEARCH OPEN FILES TO FIND THE FILE WHICH (BC93)
  B285  IS USING THIS BUFFER... >>B28B
  B28A  IF IT IS NOT FOUND, BREAK!
  B28B  ---
  B28C  MOVE THAT FILE TO THE NEW BUFFER INSTEAD (BC93)
  B28F  GET THAT FILE'S REFNUM ALSO (BC9B)
  B297  MLI: SET BUFF <BE70>
  B29A  NO ERRORS? >>B29D
  B29C  IF ERROR, BREAK!
  B29D  ---

        ******** OPEN NEW EXEC FILE *************

  B29E  SET NEW BUFFER ALLOCATION PAGE (BC88)
  B2A1  SET UP OPEN LIST FOR EXEC TOO (BECF)
  B2A6  LEVEL = 0 (BF94)
  B2AB  MLI: OPEN (EXEC FILE) <BE70>
  B2AE  NO ERROR? >>B2B7

  B2B0  ---
  B2B1  IF ERROR, FREE BUFFER FIRST <A24C>
  B2B6  THEN EXIT WITH ERROR

  B2B7  SAVE BUFFNO FOR EXEC (BECF)
  B2BD  AND REFNUM TOO (BED0)

        ******** COMPLETE EXEC COMMAND **********

  B2C3  SAVE READ REFNUM (BED6)
  B2C6  AND GET/SET REFNUM (BEC7)
  B2C9  AND NEWLINE REFNUM (BED2)
  B2CF  SET "L" VALUE FROM AUXID (BE5F)
  B2D8  SAVE PATHNAME/AUXID IN OPEN FILE TABLE <B3EB>
  B2DD  IGNORE MSB FOR END OF LINE CHARS (BED3)
  B2E2  MLI: SET NEWLINE <BE70>
  B2E8  WAS "F" OR "R" GIVEN ON COMMAND LINE?
  B2EA  NO >>B2F4
  B2EC  YES, POSITION TO SPECIFIED STARTING PT <B522>
  B2EF  NO ERRORS? >>B2F4
  B2F1  IF ERROR, GO CLOSE EXEC >>B245
  B2F4  MARK EXEC ACTIVE
  B2FA  AND RETURN TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B2FA
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

B2FB ********** CLOSE EXEC FILE ***********************************

  B2FB  EXEC ACTIVE? (BE43)
  B2FE  NO, SKIP IT >>B30B
  B300  INDICATE EXEC FILE CLOSING (BE4E)
  B305  PICK UP REFNUM FOR EXEC (BC9B)
  B308  AND GO CLOSE IT <B4A5>
  B30B  RETURN

B30C ********** "VERIFY" COMMAND ***********************************

  B30C  FILE NOT FOUND? >>B347
  B311  FILE FOUND, WAS A PATHNAME1 GIVEN?
  B313  YES >>B31D
  B315  NO,
  B317  PRINT "(C) APPLE COMPUTER..." <9F8C>
  B31A  AND A NEW LINE <9FAB>
  B31D  THEN EXIT
  B31E  RETURN

B31F ********** FLUSH ALL OPEN FILES ********************************

  B31F  REFNUM = 0 (ALL FILES)
  B321  JUMP INTO FLUSH >>B32F

B323 ********** "FLUSH" COMMAND ***********************************

  B323  ---
  B326  WAS PATHNAME1 GIVEN?
  B328  NO, FLUSH ALL FILES >>B32F
  B32A  ELSE, LOOK UP NAME IN OPEN FILE LISTS <B41F>
  B32D  NOT AN OPEN FILE >>B337
  B32F  SAVE REFNUM IN PARM LIST (BEDE)
  B334  MLI: FLUSH <BE70>
  B337  EXIT

B338 ********** "OPEN" COMMAND ************************************

  B338  ---
  B339  LOOK UP NAME IN OPEN FILE LIST <B41F>
  B33C  NOT CURRENTLY OPEN? >>B34B

  B33E  ---
  B33F  IT IS OPEN, "FILE BUSY" ERROR
  B342  RETURN
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN B4      NEXT OBJECT ADDR: B342
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  B343  "FILE TYPE MISMATCH" ERROR
  B346  RETURN

  B347  "PATH NOT FOUND" ERROR
  B349  ---
  B34A  RETURN

  B34B  ---
  B34C  ASSUME "L" IS ZERO
  B353  WAS "L" KEYWORD GIVEN?
  B355  YES, USE HIS VALUE >>B35D
  B357  NO, SET "L" TO ZERO (BE6Ø)
  B36Ø  WAS "T" GIVEN?
  B364  YES, USE HIS TYPE >>B36B
  B366  ELSE, DEFAULT TO "TXT"
  B36B  DOES THE FILE ALREADY EXIST? >>B3BE
  B36D  NO, "T" GIVEN? IF SO, ERROR >>B347
  B36F  FORCE TYPE = "TXT" (BEBB)
  B374  FULL ACCESS (BEB7)
  B37A  COPY "L" KEYWORD VALUE (BE5F)
  B37D  TO CREATE (BEA6)
  B38Ø  AND SET FILE INFO LISTS (BEBA)
  B389  GO CREATE THE FILE <AD46>
  B38C  ERROR? >>B349
  B38E  CHECK FILE TYPE (BEB8)
  B391  AGAINST HIS "T" VALUE (BE6A)
  B394  MISMATCH? >>B343
  B396  NO, TYPE = TXT?
  B39B  NO >>B3AD
  B39A  YES, GET RECORD LENGTH FROM AUXID (BEBA)
  B3A3  WAS "L" KEYWORD VALUE GIVEN?
  B3A5  YES, USE THAT INSTEAD >>B3AD
  B3A7  OTHERWISE, SAVE AUXID RECORD LEN (BE6Ø)
  B3AD  ALLOCATE A NEW FILE BUFFER <A1F5>
  B3BØ  ERROR? >>B349
  B3B2  GET BUFFER PAGE NO. (BCB8)
  B3B5  AND STORE IN OPEN LIST (BECF)
  B3BA  LEVEL = 7 (BF94)
  B3BF  MLI: OPEN <BE7Ø>
  B3C2  NO ERRORS? >>B3CB

  B3C4  ---
  B3C5  ERROR, FREE BUFFER FIRST <A24C>
  B3CA  THEN EXIT WITH ERROR CODE

  B3CB  CHECK FILE TYPE AGAIN (BEB8)
  B3CE  "DIR" FILE?
  B3DØ  YES >>B3D3
  B3D2  NO
  B3D3  ---
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN B4      NEXT OBJECT ADDR: B3D6
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  B3D6  SET DIR FLAG ACCORDINGLY (BE47)
  B3D9  USING OPEN COUNT AS AN INDEX (BE4D)
  B3DF  STORE BUFFER LOCATION IN OPEN FILE LIST (BC94)
  B3E5  ALSO, THE REFNUM (BC9C)
  B3E8  AND BUMP OPEN FILE COUNT AND FALL THRU (BE4D)

B3EB ********** SAVE FILE NAME/RECLEN IN TABLE **********************

  B3EB  MAKE INDEX FROM REFNUM*32 BYTES
  B3F1  GET NAME LENGTH (Ø2BØ)
  B3F4  OR IN DIR FLAG (BE47)
  B3F7  AND STORE IN OPEN FILE NAME LIST (BCFE)
  B3FD  NAME > OR = TO 3Ø BYTES?
  B3FF  NO... >>B4Ø3
  B4Ø1  YES, USE 29
  B4Ø3  STORE THAT AS A LOOP COUNTER
  B4Ø8  COPY "L" KEYWORD VALUE TO NAME LIST TOO (BCFF)
  B411  ---
  B412  COPY FILE NAME TO NAME LIST (Ø28Ø)
  B41B  COPY ALL OF NAME, THEN FALL THRU TO EXIT >>B411

B41D ********** "MON" AND "NOMON" COMMANDS **************************

  B41D  IGNORE THESE COMMANDS AND
  B41E  RETURN TO CALLER

B41F ********** LOOKUP OPEN FILENAME ********************************
         (RETURNS REFNUM OF OPEN FILE)

  B41F  ---
  B422  WAS PATHNAME1 GIVEN?
  B424  YES >>B42A

  B426  NO, "SYNTAX ERROR"
  B429  EXIT WITH ERROR

  B42A  ANY FILES CURRENTLY OPEN? (BE4D)
  B42D  NO, CAN'T FIND IT THEN >>B44B
  B42F  YES, CLEAR EXEC FILE CLOSING FLAG (BE4E)
  B432  STORE FILE COUNT AS LOOP COUNTER
  B434  GET NEXT REFNUM (BC9B)
  B437  COMPARE FILENAMES <B462>
  B43A  NOT THE ONE? >>B443
  B43C  ELSE, WE'VE GOT IT!
  B43E  PICK UP APPROPRIATE REFNUM (BC9B)
  B441  ---
  B442  AND RETURN WITH IT
  B443  ELSE, NOT IT, TRY NEXT ONE
  B446  AND CONTINUE LOOPING >>B432
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B446
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B448  CAN'T FIND IT, IS EXEC ACTIVE? (BE43)
  B44B  NO, THEN WE MUST GIVE UP >>B45E
  B450  IS HE LOOKING FOR EXEC FILE? <B462>
  B453  NO, GIVE UP >>B45E
  B457  YES, EXEC FILE CLOSING (BE4E)
  B45C  AND RETURN WITH EXEC'S REFNUM >>B43E

  B45E  "FILE NOT OPEN" ERROR
  B461  RETURN WITH ERROR CODE

B462 ********** COMPARE FILENAMES **********************************

  B462  REFNUM*32 FOR FILENAME INDEX
  B468  PICK UP DIR FLAG FROM THIS ENTRY  (BCFE)
  B470  SAME LENGTH AS HIS FILENAME? (0280)
  B473  NO, CAN'T BE IT THEN >>B498
  B476  MAKE SURE LENGTH DOES NOT EXCEED 29
  B47A  IF IT DOES, ONLY LOOK AT FIRST 29
  B47C  USE $3A AS LOOP COUNTER
  B481  COPY "L" OF THIS FILE TO KEYWORD (BCA4)
  B48A  ---
  B48B  COMPARE NAMES (0280)
  B491  NO MATCH? EXIT WITH Z FLAG CLEAR >>B498
  B498  MATCH, EXIT WITH Z FLAG SET

B499 ********** "CLOSE" COMMAND ************************************

  B499  ---
  B49C  PATHNAME1 GIVEN?
  B49E  NO, CLOSE ALL FILES >>B4F2
  B4A0  YES, LOOK IT UP IN OPEN FILE TABLES <B4IF>
  B4A3  NOT FOUND? >>B441
  B4A5  FOUND IT, STORE REFNUM IN CLOSE LIST (BEDE)
  B4AB  MARK BUFFER PAGE FREE (BC88)
  B4AE  EXEC CLOSING? (BE4E)
  B4B1  YES...NO NEED TO COMPRESS LISTS >>B4CF
  B4B3  GET OPEN COUNT (LAST OPENED FILE NO.) (BE4D)
  B4B7  SWAP BUFFERS (BC93)
  B4C5  AND REFNUMS WITH THE LAST OPENED FILE (BC9B)
  B4CF  ---
  B4D1  LEVEL = 0 (BF94)
  B4D6  MLI: CLOSE <BE70>
  B4D9  ERROR? >>B502
  B4DB  RELEASE THE BUFFER <A24C>
  B4DE  EXEC FILE CLOSING? (BE4E)
  B4E1  NO >>B4EE
  B4E6  YES, EXEC NO LONGER ACTIVE (BE43)
  B4E9  AND NO LONGER CLOSING (BE4E)
  B4ED  RETURN TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B4ED
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B4EE  DROP OPEN FILE COUNT (BE4D)
  B4F1  AND EXIT

B4F2 ********** CLOSE ALL OPEN FILES ********************************

  B4F2  ANY FILES OPEN? (BE4D)
  B4F5  NO >>B503
  B4F7  YES, EXEC NOT CLOSING (BE4E)
  B4FD  CLOSE LAST FILE OPENED <B4A5>
  B500  IF THAT WORKS, START ALL OVER AGAIN >>B4F2
  B502  EXIT WHEN ALL ARE CLOSED

  B503  ---
  B505  SET CLOSE REFNUM TO ZERO (ALL FILES) (BEDE)
  B50A  LEVEL = 7 (LEVEL 0 FILES ALREADY CLOSED) (BF94)
  B50F  EXIT THRU MLI: CLOSE >>BE70

B512 ********** "POSITION" COMMAND **********************************

  B512  LOOKUP NAME OF FILE <B4IF>
  B515  NOT OPEN? >>B57F
  B517  SET REFNUM IN READ/WRITE PARMLIST (BED6)
  B51A  AND SET NEWLINE LIST (BED2)
  B51D  DIR FILE? (BE47)
  B520  YES, GET OUT RIGHT NOW! >>B580

  B522  "F" OR "R" GIVEN? (BE57)
  B527  NO, INVALID PARM >>B57D
  B529  BOTH GIVEN?
  B52B  YES, INVALID PARM >>B57D
  B52D  JUST "R" GIVEN?
  B52F  NO, JUST "F" >>B53D
  B531  JUST "R", COPY "R" VALUE TO "F" (BE65)
  B534  ("R" AND "F" ARE ALIASES) (BE63)
  B53D  SET COUNT TO 239. (MAXIMUM LINE LEN)
  B54C  BUFFER IS AT $200 (BED8)
  B54F  ---
  B551  NEW LINE CHAR IS EITHER $0D OR $8D (BED3)
  B556  MLI: SET NEWLINE <BE70>
  B559  ERROR? >>B57F

        ******** SKIP LINES BY READING THEM *****

  B55B  ---
  B55E  "F" = 0? (BE64)
  B562  YES, DONE  >>B580
  B564  ELSE...
  B566  MLI: READ NEXT FIELD (LINE) <BE70>
  B569  ERROR? >>B57F
  B56E  DECREMENT "F" VALUE BY ONE
```

```
BASIC Interpreter (BI) -- VI.1 --I8 JUN 84      NEXT OBJECT ADDR: B57B
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B57B  AND GO CHECK IT AGAIN >>B55B

  B57D  "INVALID PARAMETER" ERROR
  B57F  ---
  B580  EXIT TO CALLER

B581 *********** COMPUTE NEW FILE POSITION ***************************
         (COMPUTES ABSOLUTE FILE POSITION MARK)

  B581  ACCUM = CURRENT RECORD LENGTH (BCA4)
  B595  MARK = Ø (BEC8)

         ******** MARK = "R" * RECLEN ************

  B59E  SHIFT "R" VALUE RIGHT (BE66)
  B5A6  IF LOW BIT OFF, NO ADD >>B5BF
  B5A9  ADD ONE INSTANCE OF RECLEN TO MARK (BCAF)
  B5B8  OVERFLOW? >>B5D2
  B5BD  ACCUM OVERFLOW? >>B5D2
  B5BF  SCALE ACCUM (MULTIPLIER) UP BY 2 (BCAF)
  B5C8  IF "R" NON ZERO... (BE65)
  B5CE  CONTINUE LOOPING >>B59E
  B5D1  ELSE, EXIT TO CALLER

  B5D2  "RANGE ERROR"
  B5D5  RETURN

B5D6 *********** "READ" COMMAND ***************************************

  B5D6  LOOK UP FILE NAME <B41F>
  B5D9  NOT OPEN? >>B62B
  B5DB  ITS OPEN, STORE REFNUM IN READ/WRITE... (BED6)
  B5DE  GET/SET... (BEC7)
  B5E1  AND SET NEWLINE PARMLISTS (BED2)
  B5E4  DIR FILE? (BE47)
  B5E7  YES, SPECIAL HANDLING REQUIRED >>B62C
  B5E9  NO, PRE-POSITION FOR "B", "F", OR "R" <B666>
  B5EC  ERROR POSITIONING? >>B62B
  B5EE  ASSUME "L" = 239.
  B5F5  "L" GIVEN?
  B5F7  NO >>B60C
  B5F9  YES, USE HIS "L" VALUE (BE5F)
  B5FF  UNLESS ITS >256 >>B661
  B603  OR >239. >>B661
  B607  DOUBLE QOUTE IT SO COMMAS COME THRU (Ø200)
  B60A  READ INTO $201
  B60C  IF NO "L", READ TO $200 (BED7)
  B612  NL CHAR = $ØD/$8D (OR NONE IF "L") (BED3)
  B621  MLI: SET NEWLINE <BE7Ø>
  B624  ERROR? >>B62B
  B626  ---
```

```
BASIC Interpreter (BI) -- VI.I --I8 JUN 84      NEXT OBJECT ADDR: B628
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B628  MARK INPUT "READ" FILE ACTIVE (BE44)
  B62B  AND RETURN

         ******** READ DIR FILE ******************

  B62C  SET READ/WRITE LIST REFNUM (BED6)
  B62F  AND GET/SET LIST REFNUM (BEC7)
  B634  READING TO $259 (BED7)
  B63E  INIT CAT FLAG TO FIRST LINE VALUE (BE4F)
  B644  "R" GIVEN?
  B647  NO, DONE >>B626
  B64B  YES, ZERO OUT MARK (BEC8)
  B656  MLI: REWIND FILE <BE70>
  B659  ERROR?  >>B660
  B65D  MARK INPUT FILE ACTIVE (BE44)
  B660  AND EXIT

B661 *********** "RANGE ERROR" ***************************************

  B661  "RANGE ERROR" CODE
  B665  EXIT TO CALLER

B666 *********** PRE-POSITION FOR I/O ********************************

  B666  ---
  B669  "B", "F", OR "R" GIVEN?
  B66B  NO, EXIT >>B6AF
  B66D  "R"?
  B66F  NO >>B67B
  B671  YES, COMPUTE ABSOLUTE POSITION <B581>
  B674  ERROR? >>B66I
  B676  NO, SET MARK TO NEW POSITION <B6A8>
  B679  ERROR? >>B6BØ
  B67B  "F" GIVEN? (BE57)
  B68Ø  NO >>B687
  B682  SKIP LINES UNTIL "F" = Ø <B53D>
  B685  ERROR? >>B6BØ
  B687  "B" GIVEN? (BE57)
  B68C  NO >>B6AF
  B690  MLI: GET MARK <BE70>
  B693  ERROR? >>B6BØ
  B699  ADD "B" VALUE TO CURRENT MARK (BE5A)
  B69C  (3 BYTE ADD) (BEC8)
  B6A6  OVERFLOW? >>B661
  B6A8  ---
  B6AA  MLI: SET MARK <BE70>
  B6AD  ERROR? >>B6BØ
  B6AF  ---
  B6BØ  ---
  B6B2  EXIT TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B6B2
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

B6B3 *********** "WRITE" COMMAND ***********************************

  B6B3  LOOKUP OPEN FILE NAME <B41F>
  B6B6  NOT AN OPEN FILE? >>B6C8
  B6B8  STORE READ/WRITE REFNUM (BED6)
  B6BB  AND GET/SET REFNUM (BEC7)
  B6BE  AND NEWLINE REFNUM IN PARM LISTS (BED2)
  B6C1  DIR FILE? (BE47)
  B6C4  NO, OK >>B6CA

  B6C6  YES, "FILE LOCKED" ERROR
  B6C8  ---
  B6C9  EXIT TO CALLER

  B6CA  DATA BUFFER AT $200
  B6D4  PRE-POSITION FOR "B", "F", AND "R" <B666>
  B6D7  NO ERRORS? >>B6ED
  B6D9  WAS ERROR A RANGE ERROR?
  B6DB  NO, REAL ERROR >>B6C8
  B6DD  YES, MY RANGE ERROR OR MLI'S?
  B6DF  MINE... >>B6C8
  B6E1  MLI'S...SET EOF FARTHER INTO FILE
  B6E3  MLI: SET EOF <BE70>
  B6E6  ERROR? >>B6C8
  B6E8  AND THEN TRY AGAIN TO SET MARK <B676>
  B6EB  ERROR? THEN I GIVE UP >>B6C8
  B6ED  BUFFER IS AT HIMEM
  B6F9  INDICATE OUTPUT "WRITE" FILE ACTIVE (BE45)
  B6FD  RETURN TO CALLER

B6FE *********** "APPEND" COMMAND **********************************

  B6FE  ---
  B6FF  LOOK UP NAME IN OPEN FILE LIST <B41F>
  B702  FOUND IT? >>B710
  B705  NO, OPEN IT FIRST <8338>
  B708  ERROR? >>B71E
  B70A  NO, REFNUM NON-ZERO? (BED0)
  B70D  YES, OK >>B711
  B70F  ELSE, BREAK!!!
  B710  ---
  B711  REFNUM TO READ/WRITE PARM LIST (BED6)
  B714  AND GET/SET LIST (BEC7)
  B717  DIR FILE? (BE47)
  B71A  NO >>B720
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B71A
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B71C  YES, "FILE LOCKED"
  B71E  ---
  B71F  EXIT TO CALLER

  B720  PICK UP "L" VALUE (BE5F)
  B729  DID USER SPECIFY ONE?
  B72B  YES... >>B733
  B72D  NO, USE FILE'S CURRENT "L" VALUE (BEB9)
  B733  ---
  B738  COMPUTE REFNUM*32 FOR INDEX INTO
  B739  FILE NAME TABLE
  B73E  SAVE CURRENT "L" VALUE IN OPEN FILE (BCFF)
  B741  NAME TABLE AND IN CURRENT RECLEN (BCA4)
  B74D  MLI: GET EOF <BE70>
  B750  ERROR? >>B71E
  B752  IS "L" VALUE < 2? (NO SPECIFIC "L") (BCA5)
  B755  NO >>B75E
  B75C  YES >>B763
  B75E  NO, FORCE TO RECORD BOUNDARY <B766>
  B761  ERROR? >>B71E
  B763  ELSE, GO SET EOF=MARK/OUTPUT FILE ACTIVE >>B6E1

B766 *********** FORCE TO EVEN RECORD BOUNDARY **********************
         (FIND RECORD NUMBER OF THIS POSITION)

  B766  ---
  B768  COPY EOF TO ACCUM (BEC7)
  B771  CLEAR MSB'S (BCB2)
  B777  GET READY FOR A 24 BIT DIVIDE
  B779  DIVIDE EOF BY... <AAD7>
  B786  RECORD LENGTH (BCA4)
  B79B  ---
  B7A1  WAS THERE A REMAINDER? (BCB3)
  B7A5  NO, OK... >>B7CF
  B7AB  YES, CURRENT RECORD LEN LESS REMAINDER (BCB2)
  B7B8  PLUS OLD EOF MARK (BEC8)
  B7C2  GIVES NEW EOF ON AN EVEN RECORD BOUNDARY (BEC9)
  B7CD  "RANGE ERROR" POSSIBLE IF OVERFLOW OCCURS
  B7CF  RETURN TO CALLER

87D0 *********** GET FILE INFO ***********************************

  B7D0  SET NUMBER OF PARMS (10)
  B7D5  MLI CODE FOR GET FILE INFO
  B7D7  GO DO IT >>B7EE
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B7D7
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

B7D9 *********** SET FILE INFO ***************************************

  B7D9  MODIFIED TIME/DATE = Ø
  B7E7  SET NUMBER OF PARMS (7)
  B7EC  MLI CODE FOR SET FILE INFO
  B7EE  EXIT THRU MLI: GET/SET FILE INFO >>BE7Ø

B7F1 *********** BI I/O INDIRECTION VECTORS **************************

  B7F1  DOSOUT VECTOR >>BE38
  87F4  DOSIN VECTOR >>BE3A

B7F7 *********** STATE I/O VECTORS TABLE *****************************

  B7F7  IMMEDIATE MODE (STATE=Ø) CSWL/KSWL
  B7FB  DEFERRED MODE (STATE=4) CSWL/KSWL
  B7FF                (STATE=8) CSWL/KSWL
  B8Ø3                (STATE=C) CSWL

B8Ø5 *********** SYSCT8L *********************************************
         LSB'S OF MLI CALL PARAMETER LISTS IN THE
         BI GLOBAL PAGE ($BEXX)

  B8Ø5  CREATE: $AØ  DESTROY: $AC  RENAME: $AF
  B8Ø8  SFI:    $B4  GFI:     $B4  ONLINE: $C6
  B8ØB  SPFX:   $AC  GPFX:    $AC  OPEN:   $C8
  B8ØE  NEWLINE:$D1  READ:    $D5  WRITE:  $D5
  B811  CLOSE:  $DD  FLUSH:   $DD  SMARK:  $C6
  B814  GMARK:  $C6  SEOF:    $C6  GEOF:   $C6
  B817  SBUF:   $C6  GBUF:    $C6

B819 *********** APPLESOFT TOKENS ************************************
         TOKENS REQUIRING SPECIAL ATTENTION HAVE
         THEIR MSB OFF AND ARE AN OFFSET FROM A
         JMP IN THE TRACE HANDLER IN THE BI

  8819  FIRST IS $8Ø (END)
  B823   CALL
  B833   TRACE, NOTRACE, NORMAL
  B837   INVERSE, FLASH
  B83F   RESUME
  B843   LET, IF
  B853   PRINT, LIST

8859 *********** COMMAND NAME TABLES *********************************
         OFFSETS TO LAST CHARACTER OF EACH COMMAND
         NAME IN THE COMMAND NAME TABLE BELOW.
         COMMANDS ARE ARRANGED ACCORDING TO LENGTH
         WITH THREE BYTE NAMES FIRST.  IF THE MSB
         OF AN INDEX IS ON, THEN THIS IS THE LAST
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: 8859
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------
         NAME OF THE GIVEN LENGTH (NEXT WILL BE
         ONE BYTE LONGER).

  B859  Ø1 IN#       Ø2 PR#       Ø3 CAT
  B85C  Ø4 FRE       Ø5 BYE       Ø6 RUN
  B85F  Ø7 BRUN      Ø8 EXEC      Ø9 LOAD
  B862  ØA LOCK      ØB OPEN      ØC READ
  B865  ØD SAVE      ØE BLOAD     ØF BSAVE
  B868  1Ø CHAIN     11 CLOSE     12 FLUSH
  B86B  13 NOMON     14 STORE     15 WRITE
  886E  16 APPEND    17 CREATE    18 DELETE
  B871  19 PREFIX    1A RENAME    1B UNLOCK
  B874  1C VERIFY    1D CATALOG   1E RESTORE
  B877  1F POSITION

  B878  'BSAVERIFYBLOADELETEBYECATALOGOPE'
  B898  'NWRITEXECREATEFRESTORENAMEBRUNLO'
  B8B8  'CKCHAIN#FLUSHREADPOSITIONOMONPR#'
  B8D8  'PREFIXCLOSEAPPEND'

88E9 *********** COMMAND HANDLER ADDRESS TA8LE ***********************
         ADDRESSES OF THE COMMAND HANDLER ROUTINES
         FOR EACH COMMAND IN THE ORDER GIVEN ABOVE.

  B8E9  (EXTERNAL)
  B8EB  IN#
  B8ED  PR#
  B8EF  CAT
  B8F1  FRE
  B8F3  BYE
  B8F5  RUN
  B8F7  BRUN
  B8F9  EXEC
  B8FB  LOAD
  B8FD  LOCK
  88FF  OPEN
  B9Ø1  READ
  B9Ø3  SAVE
  89Ø5  BLOAD
  B9Ø7  BSAVE
  B9Ø9  CHAIN
  89ØB  CLOSE
  89ØD  FLUSH
  B9ØF  NOMON
  B911  STORE
  8913  WRITE
  B915  APPEND
  8917  CREATE
  B919  DELETE
  891B  PREFIX
  B91D  RENAME
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B91F
ADDR    DESCRIPTION/CONTENTS

  B91F  UNLOCK
  B921  VERIFY
  B923  CATALOG
  B925 *RESTORE
  B927  POSITION
  B929  "-" COMMAND

B92B ********** PERMITTED KEYWORDS FOR CMDS **********************
         TWO BYTES PER COMMAND IN THE ORDER ABOVE.
         EACH ENTRY HAS 16 BIT SETTINGS FOR THE
         PARAMETERS PERMITTED ON THAT COMMAND.
         8000 = FETCH PREFIX, PATHNAME OPTIONAL
         4000 = SLOT (FOR PR# OR IN#)
         2000 = DEFERRED COMMAND ONLY
         1000 = FILENAME IS OPTIONAL
         0800 = IF FILE NOT FOUND, CREATE IT
         0400 = "T" (FILE TYPE) PERMITTED
         0200 = PATHNAME2 (RENAME) PERMITTED
         0100 = PATHNAME1 EXPECTED
         0080 = "A" (ADDRESS) PERMITTED
         0040 = "B" (BYTE) PERMITTED
         0020 = "E" (END ADDRESS) PERMITTED
         0010 = "L" (LENGTH) PERMITTED
         0008 = "@" (LINE NO.) PERMITTED
         0004 = "S" AND/OR "D" (SLOT/DRIVE)
         0002 = "F" (FIELD) PERMITTED
         0001 = "R" (RECORD) PERMITTED
         ("V" IS IGNORED)

       C          P S D F N T P P A B E L @ S F R
       O          F L E N E | A A | | | | | / | |
       M          X O F O W | T T | | | | | D | |
       M          | T E P F | H H | | | | | | | |
       N          | | R T I | 2 1 | | | | | | | |
       D          | | | | L | | | | | | | | | | |

  B92B  IN#        . X . . . . . . X . . . . . . .
  B92D  PR#        . X . . . . . . X . . . . . . .
  B92F  CAT        X . . X . . . X . . . . . X . .
  B931  FRE        . . . . . . . . . . . . . . . .
  B933  BYE        . . . . . . . . . . . . . . . .
  B935  RUN        . . . X . . . X . . . . X X . .
  B937  BRUN       . . . . . . . X X X X X . X . .
  B939  EXEC       . . . . . . . X . . . . . X X X
  B93B  LOAD       . . . . . . . X . . . . . X . .
  B93D  LOCK       . . . . . . . X . . . . . X . .
  B93F  OPEN       . . X . X X . X . . . X . X . .
  B941  READ       . . X . . . . X . X . X . X X X
  B943  SAVE       . . . . X . . X . . . . . X . .
  B945  BLOAD      . . . . . X . X X X X X . X . .
  B947  BSAVE      . . . . X X . X X X X X . X . .
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B949
ADDR    DESCRIPTION/CONTENTS

  B949  CHAIN      . . . . . . . X . . . . X X . .
  B94B  CLOSE      . . . . . . . X . . . . . . . .
  B94D  FLUSH      . . . . . . . X . . . . . . . .
  B94F  NOMON      . . . . . . . . . . . . . . . .
  B951  STORE      . . . . X . . X . . . . . X . .
  B953  WRITE      . . X . . . . X . X . . . . X X
  B955  APPEND     . . X . X X . X . . . X . X . .
  B957  CREATE     . . . . X X . X . . . . . X . .
  B959  DELETE     . . . . . . . X . . . . . X . .
  B95B  PREFIX     X . . X . . . X . . . . . X . .
  B95D  RENAME     . . . . . . X X . . . . . X . .
  B95F  UNLOCK     . . . . . . . X . . . . . X . .
  B961  VERIFY     . . . X . . . X . . . . . X . .
  B963  CATALOG    X . . X . X . X . . . . . X . .
  B965  RESTORE    . . . . . . . X . . . . . X . .
  B967  POSITION   . . X . . . . X . . . . . . X X
  B969  "-"        . . . . . . . X . . . . . X . .

B96B ********** KEYWORD NAME TABLE **********************************

  B96B  'ABELSDFRV@'

B975 ********** KEYWORD BIT POSITION TABLE **************************
         BIT POSITIONS IN PERMITTED PARMS TABLE
         FOR EACH KEYWORD IN THE ORDER GIVEN IN
         NAME TABLE.  "V" IS 00 (NOT USED)

  B975  ---

B97F ********** KEYWORD SIZE/OFFSET TABLE ***************************
         LOW 2 BITS - SIZE-1 OF VALUE IN BYTES
         HIGH 6 BITS- OFFSET TO LAST BYTE OF VALUE
                      FROM $BE58

  B97F  A: 2 BYTES AT +1
  B980  B: 3 BYTES AT +4
  B981  E: 2 BYTES AT +6
  B982  L: 2 BYTES AT +8
  B983  S: 1 BYTE  AT +9
  B984  D: 1 BYTE  AT +A
  B985  F: 2 BYTES AT +C
  B986  R: 2 BYTES AT +E
  B987  V: 1 BYTE  AT +10  (IGNORED)
  B988  @: 2 BYTES AT +11

B989 ********** FILE TYPES TABLES ************************************
         FILE TYPE CODES, GIVEN IN INVERSE ORDER
         TO FILE TYPE NAMES WHICH FOLLOW.
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: B989
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  B989  $FF = "SYS"
  B98A  $FE = "REL"
  B98B  $FD = "VAR"
  B98C  $FC = "BAS"
  B98D  $FB = "IVR"
  B98E  $FA = "INT"
  B98F  $F0 = "CMD"
  B990  $0F = "DIR"
  B991  $06 = "BIN"
  B992  $04 = "TXT"
  B993  $EF = "PAS"
  B994  $1A = "AWP"
  B995  $1B = "ASP"
  B996  $19 = "ADB"

  B997  ---
  B997  'ADBASPAWPPASTXTBINDIRCMDINTIVRBASVARRELSYS'

B9C1 *********** MONTH TABLE ***************************************

  B9C1  'JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC'
  B9E5  '<NO DATE>'

B9EE *********** MLIERTBL ******************************************
         MLI ERROR CODES WHICH HAVE BI EQUIVALENTS

  B9EE  ---

BA01 *********** BIERTBL *******************************************
         BI EQUIVALENTS TO MLI ERROR CODES ABOVE
         (IF MLI CODE NOT FOUND, MAPS TO LAST CODE
         IN THIS TABLE, $08 "I/O ERRROR")

  BA01  ---

BA15 *********** INDEXS TO PACKED MESSAGES *************************
         BY BI ERROR NUMBER

  BA15  ---

BA29 *********** COMMON LETTERS IN MESSAGES ************************

  BA29  ---
  BA29  'ACDEFILMNORTU '
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: BA38
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

BA38 *********** LESS COMMON LETTERS *********************************

  BA38  ---
  BA39  'BGHKPSVWXY/().:'

BA48 *********** PACKED MESSAGES ***************************************

  BA48   "COPYRIGHT APPLE COMPUTER"

  BA58  " NAME "
  BA5B  TAB($10)
  BA5D  "TYPE  BLOCKS "
  BA66  TAB($1E)
  BA68  "MODIFIED"
  BA6C  TAB($2F)
  BA6E  "CREATED "
  BA72  TAB($40)
  BA74  "ENDFILE SUBTYPE"

  BA7E  "BLOCKS FREE:"
  BA86  TAB($16)
  BA88  "BLOCKS USED:"
  BA91  TAB($2C)
  BA93  "TOTAL BLOCKS:"

  BA9C  "RANGE ERROR"                   ERROR=$2

  BAA3  "NO DEVICE CONNECTED"           ERROR=$3

  BAAE  "WRITE PROTECTED"               ERROR=$4

  BAB7  "END OF DATA"                   ERROR=$5

  BABD  "PATH NOT FOUND"              ERROR=$6,$7
  BAC0

  BAC6  "I/O ERROR"                     ERROR=$8

  BACC  "DISK FULL"                     ERROR=$9

  BAD2  "FILE LOCKED"                   ERROR=$A

  BAD9  "INVALID PARAMETER"             ERROR=$B

  BAE3  "RAM TOO LARGE"                 ERROR=$C

  BAF0  "FILE TYPE MISMATCH"            ERROR=$D
```

```
BASIC Interpreter (BI) -- V1.1 --18 JUN 84      NEXT OBJECT ADDR: BAF8
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  BAFC  "PROGRAM TOO LARGE"             ERROR=$E

  BB07  "NOT DIRECT COMMAND"            ERROR=$F

  BBII  "SYNTAX ERROR"                  ERROR=$I0

  BBI9  "DIRECTORY FULL"                ERROR=$11

  BB21  "FILE NOT OPEN"                 ERROR=$I2

  BB29  "DUPLICATE FILE NAME"           ERROR=$13

  BB34  "FILE BUSY"                     ERROR=$14

  BB3B  "FILE(S) STILL OPEN"            ERROR=$15
  BB40

BB47 *********** VARIABLES ****************************************

  BB47  NUMBER OF PAGES TO ALLOCATE/FREE
  BB4B  NOT USED
  BB49  TOP OF BUFFERS FOR GARBAGE COLLECTION
  BB4A  BOTTOM OF BUFFERS

BB4B *********** $BB4B-$BC7A NOT USED *******************************

  BB4B  NOT USED

BC7B *********** VARIABLES ****************************************

  BC7B  SAVED HIMEM VALUE DURING CHAIN LOAD
          ******** GARBAGE COLLECT MARKED GC: ****
  BC7C  GC: HIRANGE - WORKSAREASIZE
  BC7D  GC: WORKAREA MSB
  BC7E  GC: NUMBER OF PAGES IN WORKAREA
  BC7F  GC: LORANGE (START OF STRINGS TO COPY)
  BC80  GC: HIRANGE (END OF STRINGS TO COPY)
  BC81  ARRAYS START LSB
  BC82  ARRAYS ENDING MSB+1
  BC83  GC: START OF STRING AREA (ALSO PGM START)
  BC85  GC: END OF STRING AREA
  BC87  MSB ADJUST FACTOR FOR STRING POINTERS
  8C88  PAGE FOLLOWING BLOCK BUFFER
          ******** STORED VARIABLES FILE HEADER ***
  BC89  COMBINED LEN OF SIMPLE/ARRAY VARS
  BC8B  LEN OF SIMPLE VARS ONLY
  BC8D  HIMEM WHEN VARS WERE COMBINED
          ****************************************
  BC8E  POINTER TO COMBINED VARIABLES/STRINGS
  BC90  LENGTH OF COMBINED VARIABLES/STRINGS
```

```
BASIC Interpreter (BI) -- V1.1 --I8 JUN 84      NEXT OBJECT ADDR: BC92
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  BC92  LENGTH OF STRINGS ONLY

  BC94  OPEN FILES' BUFFER MSBS
  BC98  OPEN EXEC FILE BUFFER MSB

  BC9C  OPEN FILES' REFERENCE NUMBERS
  BCA3  OPEN EXEC FILE REFNUM

  BCA4  CURRENT RECORD LENGTH
  BCA6  NOT USED
  BCA9  CHARACTER TO FLUSH WHEN PARSING (BLANK)
  BCAA  MAXIMUM LENGTH TO PARSE
  BCAB  ADDRESS OF COMMAND HANDLING ROUTINE
  BCAD  SIZE OF KEYWORD VALUE -I IN 8YTES
  BCAE  OFFSET INTO KEYWORD PARMS TO LAST 8YTE
  BCAF  GENERAL PURPOSE 4 BYTE ACCUMULATOR
  BCB3  MONTH
  BCB4  DAY
  BCB5  YEAR
  BCB6  ERROR MSG LEN OR LINE LEN FOR CAT/CATALOG
  BCB7  ENTRY LENGTH IN DIRECTORY FILE
  BC88  ENTRIES PER BLOCK IN DIRECTORY FILE
  BCB9  FILE COUNT FROM DIRECTORY FILE
  BCBB  DIRECTORY ENTRY NUMBER COUNTER

BCBC *********** PATHNAME 1 BUFFER ********************************

  BCBC  COMMAND OR PATH LENGTH
  8CBD  TXBUF (COMMAND OR PATHNAME STRING)
  BCFD  NOT USED

8CFE *********** OPEN FILE NAME TABLE ******************************
          (EACH ENTRY IS 32 BYTES LONG)
          (THERE ARE 8 ENTRIES)

  BCFE  FILE 0: LENGTH OF NAME
  BCFF  FILE 0: L VALUE LSB
  8D00  FILE 0: L VALUE MSB
  8D01  FILE 0: START OF NAME STRING
          (FILE NAME IS STORED BACKWARDS)
  BDFE  LAST 2 BYTES NOT USED
```

BASIC INTERPRETER GLOBAL PAGE

This page of memory is rigidly defined by the ProDOS BI. Fields given here will not move in later versions of ProDOS and may be referenced by external, user-written programs. Future additions to the global page may be made in areas which are marked "Not used".

ProDOS BI Global Page NEXT OBJECT ADDRESS: BE00

ADDR	LABEL	CONTENTS
BE00-BE02	BI.ENTRY	JMP to WARMDOS (BI warmstart vector).
BE03-BE05	DOSCMD	JMP to SYNTAX (BI command line parse and execute).
BE06-BE08	EXTRNCMD	JMP to user-installed external command parser.
BE09-BE0B	ERROUT	JMP to BI error handler.
BE0C-BE0E	PRINTERR	JMP to BI error message print routine. Place error number in A-register.
BE0F	ERRCODE	ProDOS error code (also at $DE, Applesoft ONERR code).
BE10-BE1F	OUTVEC	Default output vector in monitor and for each slot (1-7).
BE20-BE2F	INVEC	Default input vector in monitor for each slot (1-7).
BE30-BE31	VECTOUT	Current output vector.
BE32-BE33	VECTIN	Current input vector.
BE34-BE35	VDOSIO	BI's output intercept address.
BE36-BE37		BI's input intercept address.
BE38-BE3B	VSYSIO	BI's internal redirection by STATE.
BE3C	DEFSLT	Default slot.
BE3D	DEFDRV	Default drive.
BE3E	PREGA	A-register savearea.
BE3F	PREGX	X-register savearea.
BE40	PREGY	Y-register savearea.
BE41	DTRACE	Applesoft TRACE is enabled flag (MSB on).
BE42	STATE	Current intercept state. 0 = immediate command mode. >0 = deferred.
BE43	EXACTV	EXEC file active flag (MSB on).
BE44	IFILACTV	READ file active flag (MSB on).
BE45	OFILACTV	WRITE file active flag (MSB on).
BE46	PFXACTV	PREFIX read active flag (MSB on).
BE47	DIRFLG	File being READ is a DIR file (MSB on).
BE48	EDIRFLG	End of directory flag (no longer used).
BE49	STRINGS	String space count used to determine when to garbage collect.
BE4A	TBUFPTR	Buffered WRITE data length.
BE4B	INPTR	Command line assembly length.
BE4C	CHRLAST	Previous output character (for recursion check).
BE4D	OPENCNT	Number of files open (not counting EXEC).
BE4E	YXFILE	EXEC file being closed flag (MSB on).
BE4F	CATFLAG	Line type to format next in DIR file READ.
BE50-BE51	XTRNADDR	External command handler address.
BE52	XLEN	Length of command name (less one).

ProDOS BI Global Page — NEXT OBJECT ADDRESS: BE53

ADDR	LABEL	CONTENTS
BE53	XCNUM	Number of command: $00 = external $0B = OPEN $15 = WRITE $01 = IN# $0C = READ $16 = APPEND $02 = PR# $0D = SAVE $17 = CREATE $03 = CAT $0E = BLOAD $18 = DELETE $04 = FRE $0F = BSAVE $19 = PREFIX $05 = BYE $10 = CHAIN $1A = RENAME $06 = RUN $11 = CLOSE $1B = UNLOCK $07 = BRUN $12 = FLUSH $1C = VERIFY $08 = EXEC $13 = NOMON $1D = CATALOG $09 = LOAD $14 = STORE $1E = RESTORE $0A = LOCK $1F = POSITION
BE54-BE55	PBITS	Permitted command operands bits: $8000 Prefix needed. Pathname optional. $4000 Slot number only (PR# or IN#). $2000 Deferred command. $1000 File name optional. $0800 If file does not exist, create it. $0400 T: file type permitted. $0200 Second file name required. $0100 First file name required. $0080 AD: address keyword permitted. $0040 B: byte offset permitted. $0020 E: ending address permitted. $0010 L: length permitted. $0008 @: line number permitted. $0004 S or D: slot/drive permitted. $0002 F: field permitted. $0001 R: record permitted. (V always permitted but ignored.)
BE56-BE57	FBITS	Operands found on command line. Same bit assignments as above.
BE58-BE59	VADDR	A keyword value.
BE5A-BE5C	VBYTE	B keyword value.
BE5D-BE5E	VENDA	E keyword value.
BE5F-BE60	VLNTH	L keyword value.
BE61	VSLOT	S keyword value.
BE62	VDRIV	D keyword value.
BE63-BE64	VFELD	F keyword value.
BE65-BE66	VRECD	R keyword value.
BE67	VVOLM	V keyword value (ignored).
BE68-BE69	VLINE	@ keyword value.
BE6A	VTYPE	T keyword value (in hex).
BE6B	VIOSLT	PR# or IN# slot number value.

ProDOS BI Global Page — NEXT OBJECT ADDRESS: BE6C

ADDR	LABEL	CONTENTS
BE6C-BE6D	VPATH1	Primary pathname buffer (address of length byte).
BE6E-BE6F	VPATH2	Secondary pathname buffer (address of length byte).
BE70-BE84	GOSYSTEM	Call the MLI using the parameter tables which follow.
BE85	SYSCALL	MLI call number for this call.
BE86-BE87	SYSPARM	Address of MLI parameter list for this call.
BE88-BE8A		Return from MLI call.
BE8B-BE9E	BADCALL	MLI error return: translate error code to BI error number.
BE9F	BISPARE1	Not used.
BEA0-BEAB	SCREATE	CREATE parameter list.
BEAC-BEAE	SSGPRFX	GET_PREFIX, SET_PREFIX, DESTROY parameter list.
BEAF-BEB3	SRENAME	RENAME parameter list.
BEB4-BEC5	SSGINFO	GET_FILE_INFO, SET_FILE_INFO parameter list.
BEC6-BECA	SONLINE	ONLINE, SET_MARK, GET_MARK, SET_EOF, GET_EOF, SET_BUF, GET_BUF, QUIT parameter list.
BECB-BED0	SOPEN	OPEN parameter list.
BED1-BED4	SNEWLN	SET_NEWLINE parameter list.
BED5-BEDC	SREAD	READ, WRITE parameter list.
BEDD-BEDE	SCLOSE	CLOSE, FLUSH parameter list.
BEDF-BEF4	CCCSPARE	"COPYRIGHT APPLE, 1983"
BEF5-BEF7	GETBUFR	GETBUFR buffer allocation subroutine vector.
BEF8-BEFA	FREEBUFR	FREEBUFR buffer free subroutine vector.
BEFB		Original HIMEM MSB.
BEFC-BEFF		Not used.

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C600
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

C600    MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  BOOT ROM - APPLE DISK CONTROLLER    *
          *       FOR APPLE II, II+, AND IIe.    *
          *       THIS CODE RESIDES FROM $C600   *
          *       TO $C6FF, IT LOADS TRACK 0     *
          *       SECTOR 0 INTO RAM AT $800 AND  *
          *       JUMPS TO IT                    *
          *                                      *
          ****************************************

          ******** ZERO PAGE ADDRESSES ************

0026    SECTOR BUFFER POINTER
002B    SLOT NUMBER * 16 FOR INDEX
003C    WORKBYTE
003D    SECTOR WANTED
0040    TRACK FOUND
0041    TRACK WANTED

          ******** EXTERNAL ADDRESSES *************

0100    SYSTEM STACK
0300    AUXILIARY BUFFER
0356    TRANSLATE TABLE
0800    SECTORS TO LOAD
0801    ENTRY POINT
C080    PHASE0 OFF
C081    PHASE0 ON
C089    MOTOR ON
C08A    DRIVE SELECT
C08C    READ DATA REGISTER
C08E    SET READ MODE
FCA8    MONITOR WAIT ROUTINE
FF58    RTS

C600 *********** BUILD READ TRANSLATE TABLE **************************

  C600  SIGNATURE
  C602  INITIALIZE TABLE VALUE INDICATOR
  C606  STORE BIT PATTERN
  C609  SHIFT PATTERN LEFT ONE BIT
  C60A  ARE THERE ANY TWO ADJACENT BITS ON?
  C60C  NO, TRY ANOTHER PATTERN  >>C61E
  C60E  YES, TURN OFF RIGHTMOST OF EACH GROUP OF ZEROES
  C610  FLIP BITS, PAIR OF ZERO BITS NOW SINGLE ONE BIT
  C612  HIGH BIT ALWAYS ON/TURN OFF BIT WE MISSED BEFORE
  C614  --- >>C61E
  C616  SHIFT PATTERN RIGHT, MUST HAVE ONLY ONE BIT ON
```

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C617
-------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  C617  IF MORE THAN ONE BIT ON, TRY ANOTHER PATTERN  >>C614
  C619  FOUND ONE, GET TABLE VALUE
  C61A  AND STORE IT IN TABLE  (0356)
  C61D  INCREMENT TABLE VALUE INDICATOR
  C61E  GET NEXT BIT PATTERN, DONE YET
  C61F  NO, GO CHECK IT OUT  >>C606

C621 *********** DETERMINE SLOT, TURN DRIVE ON ***********************

  C621  CALL A KNOWN RTS  <FF58>
  C624  GET STACK POINTER
  C625  GET HIGH BYTE OF WHERE WE ARE  (0100)
  C628  TIMES 16 TO GET SLOT
  C62C  SAVE SLOT
  C62E  PUT IN X REG FOR INDEX
  C62F  INSURE READ MODE  (C08E)
  C635  SELECT DRIVE 1  (C08A)
  C638  TURN THE MOTOR ON  (C089)

C63B *********** RECALIBRATE DISK ARM ********************************

  C63B  PREPAIR TO STEP THE ARM 80 PHASES
  C63D  TURN A PHASE OFF  (C080)
  C640  PUT COUNTER IN ACCUMULATOR
  C641  CREATE A PHASE NUMBER (0-3)
  C643  DOUBLE IT FOR PROPER INDEX
  C644  COMBINE WITH SLOT FOR FINAL INDEX
  C646  PUT INDEX IN X REGISTER
  C647  TURN A PHASE ON  (C081)
  C64A  DELAY ABOUT 20 MICROSECONDS
  C64F  DECREMENT COUNTER
  C650  LOOP UNTIL ALL 80 ARE DONE  >>C63D

C652 *********** INITIALIZATION ***************************************

  C652  ---
  C654  SECTOR TO FIND -> $00
  C656  TRACK TO FIND -> $00
  C65A  MAIN BUFFER POINTER ($26) -> $0800
  C65C  CLEAR THE CARRY
  C65D  PUSH STATUS ON STACK

C65E *********** SEARCH FOR A VALID HEADER ***************************

  C65E  CHECK DATA REGISTER  (C08C)
  C661  LOOP UNTIL DATA IS VALID  >>C65E
  C663  IS IT A $D5?
  C665  NO, TRY AGAIN  >>C65E
  C667  YES, CHECK REGISTER AGAIN  (C08C)
  C66A  LOOP UNTIL VALID  >>C667
  C66C  IS IT AN $AA
```

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C66E
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  C66E  NO, SEE IF ITS A $D5  >>C663
  C670  YES, DELAY FOR REGISTER TO CLEAR
  C671  CHECK REGISTER  (C08C)
  C674  LOOP UNTIL VALID  >>C671
  C676  IS IT A $96
  C678  YES, WE FOUND AN ADDRESS HEADER  >>C683
  C67A  NO, HAVE WE FOUND ONE PREVIOUSLY?
  C67B  IF NOT, START OVER  >>C65C
  C67D  WAS IT AN $AD?
  C67F  YES, WE FOUND A DATA HEADER  >>C6A6
  C681  NO, START OVER  >>C65C

C683 ********** DECODE ADDRESS FIELD ********************************

  C683  INITIALIZE COUNTER
  C685  SAVE VALUE DECODED, WILL BE TRACK ON LAST PASS
  C687  READ DATA REGISTER  (C08C)
  C68A  LOOP UNTIL DATA VALID  >>C687
  C68C  SHIFT BITS INTO POSITION X1X1X1X1
  C68D  SAVE FOR LATER
  C68F  READ REGISTER FOR NEXT BYTE  (C08C)
  C692  LOOP UNTIL VALID  >>C68F
  C694  COMBINE WITH PREVIOUS 1X1X1X1X AND X1X1X1X1
  C696  DECREMENT COUNTER, DONE YET?
  C697  NO, DO ANOTHER  >>C685
  C699  KEEP THE STACK CLEAN
  C69A  IS THIS SECTOR WE WANT?
  C69C  NO, START OVER  >>C65C
  C69E  GET TRACK FOUND
  C6A0  IS IT TRACK WE WANT?
  C6A2  NO, START OVER  >>C65C
  C6A4  YES, INDICATE ADDRESS FOUND, GO LOOK FOR DATA FIELD  >>C65D

C6A6 ********** READ DATA FIELD **********************************

  C6A6  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6A8  ---
  C6AA  READ DATA REGISTER  (C08C)
  C6AD  LOOP UNTIL VALID  >>C6AA
  C6AF  EXCLUSIVE-OR WITH TRANSLATE TABLE  (02D6)
  C6B4  DECREMENT OFFSET
  C6B5  STORE BYTE IN AUXILIARY BUFFER  (0300)
  C6B8  LOOP UNTIL BUFFER FULL  >>C6A8
  C6BA  INITIALIZE OFFSET (MAIN BUFFER)
  C6BC  READ DATA REGISTER  (C08C)
  C6BF  LOOP UNTIL VALID  >>C6BC
  C6C1  EXCLUSIVE-OR WITH TRANSLATE TABLE  (02D6)
  C6C6  STORE BYTE IN MAIN BUFFER
  C6C8  INCREMENT OFFSET
  C6C9  LOOP UNTIL BUFFER FULL  >>C6BA
  C6CB  READ DATA REGISTER  (C08C)
```

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C6CE
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  C6CE  LOOP UNTIL VALID  >>C6CB
  C6D0  IS CHECKSUM OKAY?  (02D6)
  C6D3  NO, START OVER  >>C65C

C6D5 ********** MERGE MAIN AND AUXILIARY BUFFERS**********************

  C6D5  INITIALIZE OFFSET (MAIN BUFFER)
  C6D7  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6D9  DECREMENT OFFSET (AUX BUFFER)
  C6DA  IF LESS THAN ZERO RESET IT  >>C6D7
  C6DC  GET BYTE FROM MAIN BUFFER
  C6E1  ROLL IN TWO BITS FROM AUXILIARY BUFFER
  C6E6  SAVE COMPLETED DATA BYTE
  C6E8  INCREMENT OFFSET (MAIN BUFFER)
  C6E9  LOOP UNTIL WHOLE BUFFER IS DONE  >>C6D9

C6EB ********** DETERMINE IF THERE IS MORE TO DO**********************

  C6EB  INCREMENT MAIN BUFFER POINTER
  C6ED  INCREMENT SECTOR NUMBER
  C6F1  IS THERE ANOTHER SECTOR TO LOAD?  (0800)
  C6F6  YES, GO DO IT  >>C6D3
  C6F8  NO, ENTER CODE WE JUST LOADED  >>0801

C6FB ********** UNUSED ***********************************************

  C6FB  5 BYTES AT END OF PAGE ARE UNUSED
```

```
Disk Controller Boot ROM -- Apple IIc          NEXT OBJECT ADDR: C552
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

C552    MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  BOOT ROM - APPLE //c CONTROLLER ROM *
          *       THIS CODE RESIDES FROM $C552   *
          *       TO $C6FF. IT LOADS TRACK 0     *
          *       SECTOR 0 INTO RAM AT $800 AND  *
          *       JUMPS TO IT.  IF BOOT FAILS IT *
          *       THEN TRIES TO BOOT SLOT 5,     *
          *       THE PROTOCOL CONVERTER.        *
          *                                      *
          *  THIS IS THE VERSION OF THE IIC ROM  *
          *    THAT SUPPORTS THE UNIDISK 3.5,    *
          *    26 JULY 85.                       *
          *                                      *
          ****************************************

          ******** ZERO PAGE ADDRESSES ************

0001    SLOT PAGE PUT HERE DURING AUTOBOOT
00J3    RETRY COUNT (HIGH BYTE)
0026    SECTOR BUFFER POINTER
002B    SLOT NUMBER * 16 FOR INDEX
003C    WORKBYTE
003D    SECTOR WANTED
0040    TRACK FOUND
0041    TRACK WANTED
004F    DRIVE TO BOOT FROM

          ******** EXTERNAL ADDRESSES *************

0300    AUXILIARY BUFFER
0356    TRANSLATE TABLE
07DB    SCREEN LOCATION
0800    SECTORS TO LOAD
0801    ENTRY POINT
C080    PHASE0 OFF
C081    PHASE0 ON
C088    MOTOR OFF
C089    MOTOR ON
C08C    READ DATA REGISTER
C08E    SET READ MODE
C0EA    DRIVE SELECT
FCA8    MONITOR WAIT ROUTINE
```

```
Disk Controller Boot ROM -- Apple IIc          NEXT OBJECT ADDR: C552
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

C552 ********** SLOT5 CODE ****************************************

            THE FOLLOWING TWO ROUTINES ARE IN THE $C500
            AREA BUT ARE USED BY THE $C600 LOGIC.

C552 ********** BOOTFAIL ******************************************
            COME HERE IF BOOT FAILS.  PUT MESSAGE ON
            SCREEN AND GO TO SLEEP FOREVER.

  C552  17 CHARACTERS IN MESSAGE
  C557  PUT AT BOTTOM OF SCREEN (07DB)
  C55D  THEN GO TO SLEEP >>C55D

  C55F  'Check Disk Drive'

C56F ********** SKIP OVER MISCELLANEOUS CODE **********************

  C56F  SLOT 5 LOGIC IN HERE

C58E ********** BUILD READ TRANSLATE TABLE ************************

  C58E  INITIALIZE BIT PATTERN
  C590  INITIALIZE TABLE VALUE INDICATOR
  C592  STORE BIT PATTERN
  C595  SHIFT PATTERN LEFT ONE BIT
  C596  ARE THERE ANY TWO ADJACENT BITS ON?
  C598  NO, TRY ANOTHER PATTERN  >>C5AA
  C59A  YES, TURN OFF RIGHTMOST OF EACH GROUP OF ZEROES
  C59C  FLIP BITS, PAIR OF ZERO BITS NOW SINGLE BIT, ETC
  C59E  HIGH BIT ALWAYS ON/TURN OFF BIT WE MISSED BEFORE
  C5A0  --- >>C5AA
  C5A2  SHIFT PATTERN RIGHT, MUST HAVE ONLY ONE BIT ON
  C5A3  IF MORE THAN ONE BIT ON, TRY ANOTHER PATTERN  >>C5A0
  C5A5  FOUND ONE, GET TABLE VALUE
  C5A6  AND STORE IT IN TABLE  (0356)
  C5A9  INCREMENT TABLE VALUE INDICATOR
  C5AA  GET NEXT BIT PATTERN, DONE YET?
  C5AB  NO, GO CHECK IT OUT  >>C592
  C5AD  MAIN BUFFER POINTER ($26) -> $0800
  C5B1  INITIALIZE RETRY COUNT (LOW BYTE)
  C5B3  RETURN TO CALLER

C5B4 ********** SKIP OVER MISCELLANEOUS CODE **********************

  C5B4  SLOT 5 LOGIC IN HERE
```

```
Disk Controller Boot ROM -- Apple IIc          NEXT OBJECT ADDR: C5F5
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

C5F5 *********** JUMP TO BOOTFAIL ***********************************

  C5F5  BRANCH TO BOOTFAIL >>C552

  C5F8  REMAINING 8 BYTES NOT USED BY DISK II >>C576

C600 *********** INITIALIZATION *************************************

  C600  SIGNATURE
  C602  SET DRIVE -> 1
  C604  INITIALIZE RETRY COUNT (HIGH BYTE)

C608 *********** SELECT DRIVE AND TURN IT ON ************************

  C608  ---
  C60B  INITIALIZE SLOT (6)
  C60D  INITIALIZE DEVICE (1 OR 2)
  C60F  SAVE DRIVE NUMBER ON STACK
  C610  INSURE READ MODE  (C08E)
  C616  GET DRIVE NUMBER BACK
  C617  SELECT APPROPRIATE DRIVE  (C0EA)
  C61A  TURN MOTOR ON  (C089)

C61D *********** RECALIBRATE DISK ARM *******************************

  C61D  PREPAIR TO STEP THE ARM 80 PHASES
  C61F  TURN A PHASE OFF  (C080)
  C622  PUT COUNTER IN A REGISTER
  C623  CREATE A PHASE NUMBER (0-3)
  C625  DOUBLE IT FOR PROPER INDEX
  C626  COMBINE WITH SLOT FOR FINAL INDEX
  C628  PUT INDEX IN X REGISTER
  C629  TURN A PHASE ON  (C081)
  C62C  DELAY ABOUT 20 MICROSECONDS
  C631  DECREMENT COUNTER
  C632  LOOP UNTIL ALL 80 ARE DONE  >>C61F

C634 *********** INITIALIZATION *************************************

  C634  ---
  C636  SECTOR TO FIND -> $00
  C638  TRACK TO FIND -> $00
  C63A  BUILD THE TRANSLATE TABLE  <C58E>

C63D *********** COUNT RETRIES AND INDICATE ERROR IF BOOT FAILS*******

  C63D  INITIALIZE RETRY COUNT
  C63F  CLEAR THE CARRY
  C640  PUSH STATUS ON STACK
  C641  KEEP STACK CLEAN
  C642  GET SLOT
```

```
Disk Controller Boot ROM -- Apple IIc          NEXT OBJECT ADDR: C644
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  C644  DECREMEMT RETRY COUNT, TRY AGAIN?
  C646  YES, GO DO IT  >>C656
  C648  NO, TURN DRIVE OFF  (C088)
  C64B  AUTO BOOT FROM SLOT6?
  C64F  NO, FAIL NOW >>C5F5
  C651  MAYBE SLOT 5 WILL TALK TO US >>C500
  C654  TWO BYTES NOT USED >>0002
  C656  ---
  C657  DECREMENT RETRY COUNT (LOW BYTE)
  C658  IF NOT ZERO, TRY AGAIN  >>C65E
  C65A  IF SO, GO DECREMENT RETRY COUNT (HIGH BYTE)  >>C641
  C65C  SPACE FILLER TO POSITION CODE BELOW  >>C63D

C65E *********** SEARCH FOR A VALID HEADER ***************************

  C65E  CHECK DATA REGISTER  (C08C)
  C661  LOOP UNTIL DATA IS VALID  >>C65E
  C663  IS IT A $D5?
  C665  NO, TRY AGAIN  >>C657
  C667  YES, CHECK REGISTER AGAIN   (C08C)
  C66A  LOOP UNTIL VALID  >>C667
  C66C  IS IT AN $AA
  C66E  NO, SEE IF ITS A $D5  >>C663
  C670  YES, DELAY FOR REGISTER TO CLEAR
  C671  CHECK REGISTER  (C08C)
  C674  LOOP UNTIL VALID  >>C671
  C676  IS IT A $96
  C678  YES, WE FOUND AN ADDRESS HEADER  >>C683
  C67A  NO, HAVE WE FOUND ONE PREVIOUSLY?
  C67B  IF NOT, START OVER  >>C63F
  C67D  WAS IT AN $AD?
  C67F  YES, WE FOUND A DATA HEADER  >>C6A6
  C681  NO, START OVER  >>C63F

C683 *********** DECODE ADDRESS FIELD ********************************

  C683  INITIALIZE COUNTER
  C685  SAVE VALUE DECODED, WILL BE TRACK ON LAST PASS
  C687  READ DATA REGISTER  (C08C)
  C68A  LOOP UNTIL DATA VALID  >>C687
  C68C  SHIFT BITS INTO POSITION X1X1X1X1
  C68D  SAVE FOR LATER
  C68F  READ REGISTER FOR NEXT BYTE  (C08C)
  C692  LOOP UNTIL VALID  >>C68F
  C694  COMBINE WITH PREVIOUS 1X1X1X1X AND X1X1X1X1
  C696  DECREMENT COUNTER, DONE YET?
  C697  NO, DO ANOTHER  >>C685
  C699  KEEP THE STACK CLEAN
  C69A  IS THIS SECTOR WE WANT?
  C69C  NO, START OVER  >>C63F
  C69E  GET TRACK FOUND
```

```
Disk Controller Boot ROM -- Apple IIc          NEXT OBJECT ADDR: C6AØ
-------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------

  C6AØ  IS IT TRACK WE WANT?
  C6A2  NO, START OVER  >>C63F
  C6A4  YES, INDICATE ADDRESS FOUND, GO LOOK FOR DATA FIELD  >>C642

C6A6 ********** READ DATA FIELD ************************************

  C6A6  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6A8  ---
  C6AA  READ DATA REGISTER  (CØ8C)
  C6AD  LOOP UNTIL VALID  >>C6AA
  C6AF  EXCLUSIVE-OR WITH TRANSLATE TABLE  (Ø2D6)
  C6B4  DECREMENT OFFSET
  C6B5  STORE BYTE IN AUXILIARY BUFFER  (Ø3ØØ)
  C6B8  LOOP UNTIL BUFFER FULL  >>C6A8
  C6BA  INITIALIZE OFFSET (MAIN BUFFER)
  C6BC  READ DATA REGISTER  (CØ8C)
  C6BF  LOOP UNTIL VALID  >>C6BC
  C6C1  EXCLUSIVE-OR WITH TRANSLATE TABLE  (Ø2D6)
  C6C6  STORE BYTE IN MAIN BUFFER
  C6C8  INCREMENT OFFSET
  C6C9  LOOP UNTIL BUFFER FULL  >>C6BA
  C6CB  READ DATA REGISTER  (CØ8C)
  C6CE  LOOP UNTIL VALID  >>C6CB
  C6DØ  IS CHECKSUM OKAY?  (Ø2D6)
  C6D3  NO, START OVER  >>C6A2

C6D5 ********** MERGE MAIN AND AUXILIARY BUFFERS**********************

  C6D5  INITIALIZE OFFSET (MAIN BUFFER)
  C6D7  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6D9  DECREMENT OFFSET (AUX BUFFER)
  C6DA  IF LESS THAN ZERO RESET IT  >>C6D7
  C6DC  GET BYTE FROM MAIN BUFFER
  C6E1  ROLL IN TWO BITS FROM AUXILIARY BUFFER
  C6E6  SAVE COMPLETED DATA BYTE
  C6E8  INCREMENT OFFSET (MAIN BUFFER)
  C6E9  LOOP UNTIL WHOLE BUFFER IS DONE  >>C6D9

C6EB ********** DETERMINE IF THERE IS MORE TO DO**********************

  C6EB  INCREMENT MAIN BUFFER POINTER
  C6ED  INCREMENT SECTOR NUMBER
  C6F1  IS THERE ANOTHER SECTOR TO LOAD?  (Ø8ØØ)
  C6F6  YES, GO DO IT  >>C6D3
  C6F8  NO, ENTER CODE WE JUST LOADED  >>Ø801

  C6FB  5 ZERO BYTES AT END OF PAGE
```

```
Disk II Boot ROM -- Apple IIGS                    NEXT OBJECT ADDR: C600
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

C600    MODULE STARTING ADDRESS

        ***********************************
        *                                 *
        * C600 ROM - APPLE IIGS           *
        *    If an Apple IIGS has slot 6  *
        *    configured for Disk Port,    *
        *    then this code is executed   *
        *    when a boot is attempted     *
        *    from slot 6.                 *
        *                                 *
        * IIGS ROM VERSION 0              *
        *                                 *
        ***********************************

C600 ******** ZERO PAGE ADDRESSES ************************************

1       SLOT PAGE PUT HERE DURING AUTOBOOT
3       RETRY COUNT (HIGH BYTE)
26      SECTOR BUFFER POINTER
2B      SLOT NUMBER * 16
3C      WORKBYTE
3D      SECTOR WANTED
40      TRACK FOUND
41      TRACK WANTED
4F      DRIVE TO BOOT FROM

C600 ******** EXTERNAL ADDRESSES ************************************

0300    AUXILIARY BUFFER
0356    TRANSLATE TABLE
07F8    SLOT THAT OWNS C800-CFFF
07FE    UTILITY BYTE FOR SLOT 6
0800    SECTORS TO LOAD
0801    ENTRY POINT
C080    PHASE0 OFF
C081    PHASE0 ON
C088    MOTOR OFF
C089    MOTOR ON
C08C    READ DATA REGISTER
C08E    SET READ MODE
C0EA    DRIVE SELECT
E000    APPLESOFT BASIC ENTRY POINT
FABA    MONITOR DISK CONTROLLER SEARCH LOOP
FCA8    MONITOR WAIT ROUTINE
```

```
Disk II Boot ROM -- Apple IIGS                    NEXT OBJECT ADDR: C600
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

C600 ******** IIGS SOFT SWITCHES ************************************

C02D    SLTROMSEL. SLOT ROM CONFIGURATION BYTE
C035    SHADOW.  ENABLES/DISABLES SHADOWING
C068    STATEREG.  ONE BYTE SETS 8 SOFT SWITCHES

C600 ******** C600 ENTRY POINT **************************************

  C600  ---
  C600  SIGNATURE
  C602  SET DRIVE TO DRIVE 1
  C604  INITIALIZE RETRY COUNT (HIGH BYTE)
  C608  PUSH 0 ON STACK
  C60A  SET NORMAL ZERO PAGE
  C60C  SET DATA BANK SAME AS PROGRAM BANK
  C60F  MAKE SLOT 6 CURRENT  (07F8)
  C612  8-BIT MEMORY AND INDEX OPERATIONS
  C616  STORE P-REGISTER IN SCREEN HOLE  (07FE)
  C619  DISABLE INTERRUPTS
  C61A  GO DO SOME TASKS ELSEWHERE IN ROM  <FF5909>
  C61E  RESTORE SLOT*16 TO X-REGISTER
  C620  IF CARRY SET, I/O ERROR  >>C62E

C622 ******** COUNT RETRIES AND INDICATE ERROR ***********************
                        IF BOOT FAILS

  C622  INITIALIZE RETRY COUNT
  C624  DISABLE INTERRUPTS (AGAIN)
  C625  CLEAR CARRY AND
  C626  PUT IT ON THE STACK.
  C627  KEEP STACK EVEN
  C628  GET SLOT*16 IN X-REGISTER
  C62A  DECREMENT RETRY COUNT. TRY AGAIN?
  C62C  YES, GO DO IT  >>C656
  C62E  NO, TURN DRIVE OFF  (C088)
  C631  CALL BOOT ERROR HANDLER  <FF5971>
  C635  ENABLE INTERRUPTS IF OK TO  <C648>
  C638  AUTOBOOT FROM SLOT 6?
  C63D  NO, GO TO BASIC  >>C642
  C63F  YES, RETURN TO SLOT SEARCH LOOP  >>FABA
  C642  JUMP TO BASIC  >>E000

C645 ******** SUBROUTINE TO ENABLE INTERRUPTS ************************

  C645  ALLOW SHADOWING AND I/O  (C035)
  C648  CHECK ORIGINAL P-REGISTER  (07FE)
  C64B  INTERRUPT BIT HIGH?
  C64D  YES, LEAVE INTERRUPTS DISABLED  >>C650
  C64F  NO, ENABLE INTERRUPTS
  C650  RESTORE SECTOR TO ACCUMULATOR
  C652  RETURN
```

```
Disk II Boot ROM -- Apple IIGS                          NEXT OBJECT ADDR: C652
-------------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------------

C653 ******** THREE BYTES NOT USED **********************************

  C653  NOT USED

C656 ******** INCREMENT RETRIES **************************************

  C656  ---
  C657  DECREMENT RETRY COUNT (LOW BYTE)
  C65B  IF NOT ZERO, TRY AGAIN  >>C65E
  C65A  ZERO, SO GO DECREMENT HIGH BYTE  >>C627
  C65C  SPACE FILLER TO POSITION CODE BELOW  >>C622

C65E ******** SEARCH FOR A VALID HEADER ******************************

  C65E  CHECK DATA REGISTER  (C08C)
  C661  LOOP UNTIL DATA IS VALID  >>C65E
  C663  IS IT A $D5?
  C665  NO, TRY AGAIN  >>C657
  C667  YES, CHECK REGISTER AGAIN  (C0BC)
  C66A  LOOP UNTIL VALID  >>C667
  C66C  IS IT AN $AA?
  C66E  NO, SEE IF IT'S A $D5  >>C663
  C670  YES, DELAY FOR REGISTER TO CLEAR
  C671  CHECK REGISTER  (C08C)
  C674  LOOP UNTIL VALID  >>C671
  C676  IS IT A $96?
  C67B  YES, WE FOUND AN ADDRESS HEADER  >>C683
  C67A  NO. ARE WE LOOKING FOR DATA HEADER?
  C67B  NO, SO START OVER  >>C625
  C67D  YES, WAS IT AN #$AD?
  C67F  YES, WE FOUND A DATA HEADER  >>C6A6
  C681  NO, START OVER  >>C625

C6B3 ******** DECODE ADDRESS FIELD **********************************

  C683  INITIALIZE COUNTER
  C685  SAVE VALUE DECODED, WILL BE TRACK ON LAST PASS
  C687  READ DATA REGISTER  (C08C)
  C68A  LOOP UNTIL DATA VALID  >>C687
  C68C  SHIFT BITS INTO POSITION X1X1X1X1
  C68D  SAVE FOR LATER
  C68F  READ REGISTER FOR NEXT BYTE  (C0BC)
  C692  LOOP UNTIL VALID  >>C6BF
  C694  COMBINE WITH PREVIOUS 1X1X1X1X AND X1X1X1X1
  C696  DECREMENT COUNTER. DONE YET?
  C697  NO, DO ANOTHER  >>C685
  C699  KEEP STACK CLEAN
  C69A  IS THIS SECTOR WE WANT?
  C69C  NO, START OVER  >>C625
  C69E  GET TRACK FOUND
```

```
Disk II Boot ROM -- Apple IIGS                          NEXT OBJECT ADDR: C6A0
-------------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-------------------------------------------------------------------------------

  C6A0  IS IT TRACK WE WANT?
  C6A2  NO, START OVER  >>C625
  C6A4  YES, INDICATE ADDR FOUND, GO LOOK FOR DATA FIELD  >>C628

C6A6 ******** READ DATA FIELD **************************************

  C6A6  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6AB  ---
  C6AA  READ DATA REGISTER  (C08C)
  C6AD  LOOP UNTIL VALID  >>C6AA
  C6AF  EXCLUSIVE-OR WITH TRANSLATE TABLE  (02D6)
  C6B4  DECREMENT OFFSET
  C6B5  STORE BYTE IN AUXILIARY BUFFER  (0300)
  C6B8  LOOP UNTIL BUFFER FULL  >>C6A8
  C6BA  INITIALIZE OFFSET (MAIN BUFFER)
  C6BC  READ DATA REGISTER  (C0BC)
  C6BF  LOOP UNTIL VALID  >>C6BC
  C6C1  EXCLUSIVE-OR WITH TRANSLATE TABLE  (02D6)
  C6C6  STORE BYTE IN MAIN BUFFER
  C6C8  INCREMENT OFFSET
  C6C9  LOOP UNTIL BUFFER FULL  >>C6BA
  C6CB  READ DATA REGISTER  (C08C)
  C6CE  LOOP UNTIL VALID  >>C6CB
  C6D0  IS CHECKSUM OKAY?  (02D6)
  C6D3  NO, START OVER  >>C6A2

C6D5 ******** MERGE MAIN AND AUXILIARY BUFFERS **********************

  C6D5  INITIALIZE OFFSET (MAIN BUFFER)
  C6D7  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6D9  DECREMENT OFFSET (AUX BUFFER)
  C6DA  IF LESS THAN ZERO RESET IT  >>C6D7
  C6DC  GET BYTE FROM MAIN BUFFER
  C6E1  ROLL IN TWO BITS FROM AUXILIARY BUFFER
  C6E6  SAVE COMPLETED DATA BYTE
  C6E8  INCREMENT OFFSET (MAIN BUFFER)
  C6E9  LOOP UNTIL WHOLE BUFFER IS DONE  >>C6D9

C6EB ******** DETERMINE IF THERE IS MORE TO DO **********************

  C6EB  INCREMENT MAIN BUFFER POINTER
  C6ED  INCREMENT SECTOR NUMBER
  C6F1  IS THERE ANOTHER SECTOR TO LOAD?  (0800)
  C6F6  YES, GO DO IT  >>C6D3
  C6FB  NO. ENABLE INTERRUPTS  <C645>
  C6FB  AND JUMP TO CODE WE JUST LOADED.  >>0801
```

```
Disk II Boot ROM -- Apple IIGS                    NEXT OBJECT ADDR: C6FB
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  C6FE  LAST TWO BYTES ARE ZERO



        ****************************************
        *                                      *
        *     SUBROUTINES ELSEWHERE IN ROM     *
        *        (BANK $FF -- IIGS ROM)        *
        *                                      *
        ****************************************

5909 ******** SELECT DRIVE AND TURN IT ON ****************************

  5909  ---
  590C  INITIALIZE SLOT TO 6
  590E  INITIALIZE DEVICE (1 OR 2)
  5910  INSURE READ MODE  (C08E)
  5916  SELECT APPROPRIATE DRIVE  (C0EA)
  5919  TURN MOTOR ON  (C089)

591C ******** RECALIBRATE DISK ARM ***********************************

  591C  PREPARE TO STEP THE ARM 80 PHASES
  591E  TURN A PHASE OFF  (C080)
  5921  PUT COUNTER IN A-REG
  5922  CREATE A PHASE NUMBER (0-3)
  5924  DOUBLE IT FOR PROPER INDEX
  5925  COMBINE WITH SLOT FOR FINAL INDEX
  5927  PUT INDEX IN X REGISTER
  5928  TURN A PHASE OFF  (C081)
  592B  DELAY ABOUT 20 MICROSECONDS
  592D  SAVE P-REGISTER
  592E  AND DISABLE INTERRUPTS
  592F  WHILE WAITING.  <FCA8>
  5932  RESTORE P-REGISTER
  5933  DECREMENT COUNTER
  5934  LOOP UNTIL ALL 80 ARE DONE  >>591E

5936 ******** SET VARIABLES TO ZERO **********************************

  5936  ZERO LOW BYTE, BUFFER ADDRESS
  5938  SECTOR = 0
  593A  TRACK = 0
  593C  CLEAR CARRY, INDICATING READABLE DISK
  593D  TRY 50 READS
  593F  READ DATA REGISTER  (C08C)
  5942  FOUND SOMETHING!  >>5948
  5944  DECREMENT COUNTER
  5945  AND TRY AGAIN.  >>593F
  5947  CAN'T FIND ANY DATA.  SET ERROR INDICATOR.
```

```
Disk II Boot ROM -- Apple IIGS                    NEXT OBJECT ADDR: 5947
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

5948 ******** BUILD READ TRANSLATE TABLE ****************************

  5948  SAVE P-REGISTER
  5949  INITIALIZE BIT PATTERN
  594B  INITIALIZE TABLE VALUE INDICATOR
  594D  STORE BIT PATTERN
  5950  SHIFT PATTERN LEFT ONE BIT
  5951  ARE THERE ANY TWO ADJACENT BITS ON?
  5953  NO, TRY ANOTHER PATTERN  >>5966
  5955  YES, TURN OFF RIGHTMOST OF EACH GROUP OF ZEROS.
  5957  FLIP BITS, PAIR OF ZERO BITS NOW SINGLE BIT, ETC.
  5959  HIGH BIT ALWAYS ON/TURN OFF BIT WE MISSED BEFORE
  595B  --- >>5966
  595D  SHIFT PATTERN RIGHT, MUST HAVE ONLY ONE BIT ON
  595E  IF MORE THAN ONE BIT ON, TRY ANOTHER PATTERN  >>595B
  5960  FOUND ONE, GET TABLE VALUE
  5961  AND STORE IT IN TABLE.  (000356)
  5965  INCREMENT TABLE VALUE INDICATOR
  5966  GET NEXT BIT PATTERN. DONE YET?
  5967  NO, GO CHECK IT OUT  >>594D
  5969  MAIN BUFFER POINTER ($26) -> $800
  596D  INITIALIZE RETRY COUNT
  596F  RESTORE P-REGISTER
  5970  BACK TO $C600 CODE

5971 ******** HANDLE BOOT ERROR *************************************

  5971  SET "NOT A STARTUP DISK" ERROR
  5977  JUMP INTO BOOT ERROR LOGIC  >>63D6


63D6 ******** BOOT ERROR LOGIC *************************************

  63D6  GET INTO NATIVE MODE
  63D8  SAVE P-REGISTER ON STACK
  63D9  8-BIT MEMORY AND INDEX OPERATION
  63DB  AUTO BOOT FROM THIS SLOT?
  63E1  YES, DON'T PRINT ERROR MESSAGE  >>6423
  63E3  SET DATA BANK REGISTER TO BANK 0  <6307>
  63E6  SAVE SLOTROM STATUS  (C02D)
  63EA  ENABLE SMARTPORT/DISKPORT FOR SLOTS 5 AND 6
  63EF  SAVE STATEREG  (C068)
  63F3  READ ROM
  63F8  GET INTO EMULATION MODE
  63FB  SET AND CLEAR NORMAL SCREEN IN PREPARATION  <00C593>
          TO PRINT SYSTEM ERROR MESSAGE ON ROW 10.
  6400  RESTORE EMULATION MODE
  6402  RESTORE SOFT SWITCHES  (C068)
  6406  RESTORE SLOTROM STATUS  (C02D)
```

```
Disk II Boot ROM -- Apple IIGS                    NEXT OBJECT ADDR: 6409
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  6409  SET MSG CODE=0 ("I/O ERROR")
  640B  IS ERROR CODE ZERO?  (E10FB1)
  640F  NO, KEEP CHECKING  >>6413
  6411  YES, SET MSG CODE=1 ("NOT A STARTUP DISK")
  6413  IS IT "NO DEVICE CONNECTED"?
  6415  NO.  >>6419
  6417  YES, SET MSG CODE=2
  6419  IS IT "CHECK STARTUP DEVICE"?
  641B  NO, CALL IT "I/O ERROR"  >>641F
  641D  YES, SET MSG CODE=3
  641F  PUT MSG CODE IN ACCUM
  6420  AND PRINT IT OUT  <C080>
  6423  INDICATE I/O ERROR
  6425  GET P-REGISTER BACK
  6426  RESTORE MODE BASED ON CARRY
  6427  INDICATE ERROR
  6428  RETURN TO $C600 LOGIC
```

APPENDIX A

DIFFERENCES BETWEEN THE PRODOS 8 VERSIONS

This Appendix identifies the changes to ProDOS 8 that were introduced with the 1.2 and 1.3 versions. Although we believe this to be a fairly thorough list, there may have been a few changes (especially deletions) that we didn't catch. Quite a few changes that were apparently made only to save space are not listed here.

CHANGES INTRODUCED IN THE 1.2 VERSION

The changes that were made to the 1.1.1 version of ProDOS to produce ProDOS 8, Version 1.2, are listed below. Addresses given here are Version 1.2 addresses.

Relocator

1. When running on a IIGS with ProDOS 16 installed, ProDOS 8 is entered from PQUIT (the ProDOS 16 Quit Handler). In this case the Relocator is entered at $2003 instead of $2000. [2000-2005, page 11].
2. The ProDOS 8 version number is now stored in the MLI subdirectory header data area [2048-204C, page 11].
3. Always checks to see if running on a IIGS, and if so sets a flag (2278). Also sets E100BD=0 if ProDOS 8 is the initial boot on a IIGS. [2079-208D, page 11].
4. Sets aux stack pointer to $FF [20E6-20F5, 2111-2115, page 12].
5. If operating on a IIGS, skips logic that searches for slot 3 80-column card [212A-2139, page 12].
6. If operating on a IIGS, installs the IIGS Clock Code [21AD-21D0, 22D3-22DA, pages 12 and 14].
7. Now checks for an AppleTalk Initialization File (ATINIT file) before looking for a .SYSTEM file. If the ATINIT file is found, it is loaded and executed, then the search for a .SYSTEM file commences. [22DB-2381, page 14].
8. The list of devices is now ordered differently. It recognizes the SmartPort and allows four Slot 5 SmartPort units to be accessed as Slot 5, Drives 1 and 2 and Slot 2, Drives 1 and 2. If Slot 2 is being used by a storage device, however, only the first two devices on the Slot 5 SmartPort can be accessed. It also changes the search order, making sure that Disk II devices are searched last when a device scan takes place (such as during an MLI ON_LINE call). [2668-271B, 275D-2767, 2814-28AA, pages 17-19].

9. A bug in the /RAM driver (which we pointed out in the 1.1.1 supplement) that allowed a block read of block 7 (which doesn't exist) has been corrected [2D4B, page 23].
10. The /RAM caller, which operates in high RAM, now contains a $60 (RTS instruction) at address $FF58. Peripheral cards sometimes call that address to figure out which slot they are in, and in case they forget to set ROM for reading, the call will still work. [2E56-2E58, page 24].
11. A subroutine that sets high RAM for reading/writing was created to save space in the code [2518-251E, page 16].

MLI and MLI Global Page

1. The Global Page now pushes the P-Register and disables interrupts before calling the actual MLI [DE01-DE04, DE1C-DE21, BF4B-BF4F, pages 34 and 75].
2. Setting the MLIACTIVE flag a little differently now allows nested calls to the MLI by interrupt routines [DE8F-DE91, page 35].
3. A new MLI command was introduced (command=$82), that allows the user to install a routine to handle unclaimed interrupts [DEFF-DF0B, FD23-FD2C, pages 35 and 63].
4. If there is no unclaimed interrupt handler, ProDOS 8 now counts unclaimed interrupts, and will allow 255 of them to occur before finally issuing a fatal error. This allows a brief time for the unknown interrupt to stop interrupting. [DFB3-DFB7, page 36].
5. If operating on a IIGS and system death occurs, the NEWVIDEO softswitch is set to 0, reinitializing the IIGS video [E013-E016, page 36].
6. Processing for the ON_LINE command now frees the VCB entry for a device that was previously on-line but has been taken off-line [E28A-E2A4, page 39].
7. A subroutine that reads a block where the block number is in the A and X registers was added to save space in the code [EBC9-EBD0, page 47].
8. The error message that results when a file being opened has an illegal storage type has been changed from "incompatible directory format" to "unsupported storage type" [EEC7-EECA, page 50].
9. An error type $C is now indicated when truncating or deleting a file and the file's storage type is illegal [FA4D-FA4E, page 60].
10. To save space in the QuitCode Caller, some in-line code was changed to a loop [FCAF-FCB7, FCD8-FCE0, page 62].

Quit Code

1. Uses standard character set instead of alternate character set [1006-1008, page 77].
2. Sets normal 40-column screen in a safer way, such that screen hole values are preserved [100C-1011, page 77].
3. Message display routine is modified [1033-1034, 11D6-11D1, etc., pages 77 and 79].
4. The method of displaying the current prefix is changed so that it is always written to the same screen location [104D-105C, page 77].
5. User can now backspace with the DELETE key as well as left arrow [107C-107F, 10FC-10FF, page 78].
6. The method of inputting the Application name was modified [10E7-10E9, page 78].

Clock Code

1. The code for the ThunderClock includes a lookup table to determine the year based on the day of the year and the day of the week. This table is only good for a span of five or six years. The table released with Version 1.1.1 was good for the years 1982-1987. The table released with Version 1.2 covers the years 1986-1991. [D7B8-D7BE, page 91].
2. A completely separate clock routine is provided in Version 1.2 in case ProDOS 8 is operating on a IIGS. If so, the IIGS Clock Code is always enabled. It is written in 65816 and calls the ReadTimeHex tool in the tool kit to read the clock. [D742-D790, page 92].

CHANGES INTRODUCED IN THE 1.3 VERSION

The changes that were made to the 1.2 version of ProDOS 8 to produce ProDOS 8, Version 1.3, are listed below. Addresses given here are Version 1.3 addresses.

Relocator

1. The boot message now includes a line that says "ALL RIGHTS RESERVED." Chalk up one for the legal department! [25F6-2671, page 26].
2. A ProDOS Status call now immediately precedes the SmartPort Status Call. This is because the SmartPort interface does not set up its device list until it receives a ProDOS Status call. Earler versions of ProDOS 8 may not always find all SmartPort devices. [286E-2894, page 28].

MLI

1. When files are deleted, previous versions of ProDOS zero out all but the first block of discarded index blocks. Now such index blocks will not be zeroed, but the pages of these blocks will be flipped. That is, the high byte of the block numbers will be exchanged with the low byte of the block numbers. [F992-F99A, FBC7-FBDC, pages 67 and 69].
2. Previous versions of ProDOS forgot, in certain cases, to rewrite index blocks that were being discarded when shortening or deleting files. Now such blocks will always be rewritten to disk in a zeroed (shortened file) or flipped (deleted file) form. [FAB8-FABC, FB91-FB93, pages 68 and 69].
3. A poorly-written loop in the QuitCode Caller that was added for Version 1.2 was rewritten for Version 1.3. The Version 1.2 code might cause problems on a IIGS. [FDØ5-FDØC, page 7Ø].

Disk II Device Driver

1. There is a routine in the Disk II Device Driver that clears phases in case the Disk II device is sharing transmission lines with SmartPort devices. This routine was patched in Version 1.3 so that phases are now cleared with LDA instructions instead of STA instructions. This eliminates bus fights that can, in some situations, cause unwanted writing to the floppy disk. [D6C3-D6CE, page 88].

BUGS IN VERSIONS 1.2 AND 1.3

It is fair to say that both Versions 1.2 and 1.3 of ProDOS 8 are relatively bug free. Perhaps a few escaped our notice, but we know of only three minor bugs, which are as follows:

MLI, Versions 1.2 and 1.3, at EC64 (see p. 47). This bug has been in ProDOS since day 1. Although there is no easy way to correct the problem (because a three-byte instruction is needed where there are only two bytes), any serious problems can be avoided by putting NOP's at EC64 and EC65 (3D64 and 3D65 in load location). This bug can only take effect when a storage type Ø is found (not likely unless disk swapping) and a lot of files are open simultaneously.

MLI, Version 1.2 only, at FCD8 (see p. 62). A loop that indexes around the 64K boundary may cause problems on a IIGS. Use version 1.3 or recode the loop so that the boundary crossover is eliminated.

MLI, Version 1.3 only, at FBCD (see p. 69). A 65CØ2 instruction snuck into the code, which will be disastrous when Version 1.3 is run on a computer with a 65Ø2 processor (Apple II+, unenhanced IIe). It is easily patched, as we explain on page 69.

APPENDIX B

ERRATA TO BENEATH APPLE PRODOS

ERRATA TO BENEATH APPLE PRODOS (1st Printing, 1984)

You can identify which printing of Beneath Apple ProDOS you have by looking at the space between the title of the book and the author's names on the first page of the book (the title page). If this space is blank, you have the first printing. The second printing has "Second Printing, March 1985" in this space. If you have the second printing, skip to page 120. If you have the first printing, all of the following errata apply.

Page 3-16:

In the first paragraph starting on the page, the sentence should read "The data is dealt with in larger pieces (512 **bytes** vs. 256 **bytes**)...", not **512K** vs. **256K.**

Page 6-63:

The code for "HOW MUCH MEMORY IS IN THIS MACHINE?" is incorrect. Replace it with:

```
        LDA   $BF98       GET MACHID FROM GLOBAL PAGE
        ASL   A           MOVE BITS TO TEST POSITION
        ASL   A
        BPL   SMLMEM      48K
        ASL   A
        BVS   MEM128      128K
        ...               OTHERWISE 64K
```

Page 6-64:

The code for "GIVEN A PAGE NUMBER, SEE IF IT IS FREE" is incorrect. Replace it with:

```
BITMAP  EQU   $BF58        SEE PAGE 8-6
        LDA   #PAGE       GET PAGE NUMBER (MSB OF ADDR)
        JSR   LOCATE      LOCATE ITS BIT IN BITMAP
        AND   BITMAP,Y    IS IT ALLOCATED?
        BNE   INUSE       YES, CAN'T TOUCH IT
        TXA               PUT BIT PATTERN IN ACCUM
        ORA   BITMAP,Y    MARK THIS PAGE AS IN USE
        STA   BITMAP,Y    UPDATE MAP
        ...               WE'VE GOT IT NOW
```

```
LOCATE  PHA                 SAVE PAGE NUMBER
        AND   #Ø7           ISOLATE BIT POSITION
        TAY                 THIS IS INDEX INTO MASK TABLE
        LDX   BITMASK,Y     PUT PROPER BIT PATTERN IN X
        PLA                 RESTORE PAGE NUMBER
        LSR   A             DIVIDE PAGE BY 8
        LSR   A
        LSR   A
        TAY                 Y-REG IS OFFSET INTO BITMAP
        TXA                 PUT BIT PATTERN IN ACCUM
        RTS                 DONE

BITMASK DFB   $8Ø,$4Ø,$2Ø,$1Ø  BIT MASK PATTERNS
        DFB   $Ø8,$Ø4,$Ø2,$Ø1
```

Page 7-9

The code on page 7-9 is incorrect and should be replaced with the following:

```
*       SQUISH OUT DEVICE NUMBER FROM DEVLST
        SKP 1
        LDX   $BF31         GET DEVCNT
DEVLP   LDA   $BF32,X       PICK UP LAST DEVICE NUM
        AND   #$7Ø          ISOLATE SLOT
        CMP   #$3Ø          SLOT = 3?
        BEQ   GOTSLT        YES, CONTINUE
        DEX
        BPL   DEVLP         CONTINUE SEARCH BACKWARDS
        BMI   NORAM         CAN'T FIND IT IN DEVLST
GOTSLT  LDA   $BF32+1,X     GET NEXT NUMBER
        STA   $BF32,X       AND MOVE THEM FORWARD
        INX
        CPX   $BF31         REACHED LAST ENTRY?
        BNE   GOTSLT        NO, LOOP
        DEC   $BF31         REDUCE DEVCNT BY 1
        LDA   #Ø            ZERO LAST ENTRY IN TABLE
        STA   $BF32,X
        CLC
        BCC   OKXIT         BRANCH ALWAYS TAKEN
        SKP   1
OLDVEC  DW    Ø             OLD VECTOR SAVEAREA
```

To reinstall the /RAM driver, execute this subroutine:

```
          SKP   1
*         SEE IF SLOT 3 HAS A DRIVER ALREADY
          SKP   1
HIMEM     EQU   $73         PTR TO BI'S GENERAL PURPOSE BUFFER
          SKP   1
INSTALL   LDX   $BF31       GET DEVCNT
INSLP     LDA   $BF32,X     GET A DEVNUM
          AND   #$70        ISOLATE SLOT
          CMP   #$30        SLOT 3?
          BEQ   INSOUT      YES, SKIP IT
          DEX
          BPL   INSLP       KEEP UP THE SEARCH
          SKP   1
*         RESTORE THE DEVNUM TO THE LST
          SKP   1
          LDX   $BF31       GET DEVCNT AGAIN
          CPX   #$0D        DEVICE TABLE FULL?
          BNE   INSLP2
ERROR     ...               YOUR ERROR ROUTINE

INSLP2    LDA   $BF32-1,X   MOVE ALL ENTRIES DOWN
          STA   $BF32,X     TO MAKE ROOM AT FRONT
          DEX               FOR A NEW ENTRY
          BNE   INSLP2
          LDA   #$B0
          STA   $BF32       SLOT 3, DRIVE 2 AT TOP OF LIST
          INC   $BF31       UPDATE DEVCNT
          SKP   1
```

Page 7-26:

Modifying the ProDOS Disk II Device Driver to allow 320 blocks instead of the normal 280. The fourth command line should read:

```
520D:40
```

Modifying FILER to format 40 tracks instead of 35. The fourth command line should read:

```
4244:40
```

[See Second printing errata for information about versions other than 1.0.1]

Page 8-6:

Under "Device Information", make the following changes:

```
BF1Ø-BF11    DEVADRØ1    Slot Ø reserved.
...
BF26-BF27    DEVADR32    /RAM device driver address
                         (need extra 64K).
```

Page 8-7:

The wrong bit is indicated as the "expansion bit" in the MACHID byte. The first eight rows of that description should read:

```
ØØ.. Ø...  II
Ø1.. Ø...  II+
1Ø.. Ø...  IIe
11.. Ø...  III emulation
ØØ.. 1...  Future expansion
Ø1.. 1...  Future expansion
1Ø.. 1...  IIc
11.. 1...  Future expansion
```

Page B-8:

In the last paragraph, the sentence should read "A second way to use **an interpreted** language..." (not **a compiled** language).

Page D-1:

In the second paragraph, the sentence should read "Versions of the Disk Drive Controller Unit are now **used...**" (not **based**).

Reference Card, Panel 4

Under "SYSTEM GLOBAL PAGE FORMAT", replace the lines beginning BFØ5 and BFØ6 with the following two lines:

```
BFØ6    Jump to Date/Time Address
        (or RTS if no clock)
```

The description of BF1Ø-11 should be changed to:

BF1Ø-11 Slot Ø reserved

The description of BF26-27 should be changed to:

BF26-27 /RAM

Under the "MACHINE IDENTIFICATION BYTE", the second column of numbers should read:

Ø...
Ø...
Ø...
Ø...
1...
1...
1...
1...

Reference Card, Panel 9

The last entry for "MLI ERROR CODES" should be:

$5A Bad vol. bit map

(not **$58**).

ERRATA TO BENEATH APPLE PRODOS (2nd Printing, 1985)

Page 4-30:

The definitions of PARENT POINTER and PARENT ENTRY are incorrect. Replace them with:

$27-$28 PARENT_POINTER: The block number (within the volume directory or a subdirectory) which contains the file entry for this subdirectory.

$29 PARENT_ENTRY: The number of the file entry within the block number pointed to by the PARENT_POINTER. Given that "ENTRIES_PER_BLOCK" is $0D, then the PARENT_ENTRY number ranges from $01 to $0D.

Page 6-62:

The paragraph immediately preceding Table 6.6 should read as follows:

If an error occurs, the BI error code will be placed in the accumulator. Possible codes are listed in Table 6.6.

In Table 6.6, the message for error code $0C is wrong. It should read:

$0C NO BUFFERS AVAILABLE

Page 7-26:

Expand the 40-track drive patch to show how to patch all of the versions of ProDOS 8 released to date.

This patch modifies the Disk II Driver, which is a part of the "PRODOS" file (or "P8" file), so that it allows 320 blocks per volume instead of 280 blocks per volume. First set the prefix to the directory that contains the file you want to modify. This file will normally be called "PRODOS" on an 8-bit Apple II and "P8" on a 16-bit Apple IIGS. If the file name is not "PRODOS," substitute the correct filename wherever "PRODOS" appears.

```
UNLOCK PRODOS
BLOAD PRODOS,TSYS,A$2000
CALL -151
address*:40
3D0G
BSAVE PRODOS,TSYS,A$2000
LOCK PRODOS
```

*"address" varies with the version of ProDOS, as follows:

ProDOS Version	address
1.Ø.1	52ØD
1.Ø.2	52CD
1.1.1	56E3
1.2	58E3
1.3	58E3

The following patch modifies the program FILER to format 4Ø tracks instead of 35. After this modification is made, only 4Ø-track drives may be formatted with FILER.

```
UNLOCK FILER
BLOAD FILER,TSYS,A$2ØØØ
CALL -151
addr**:4Ø
79F4:28
3DØG
BSAVE FILER,TSYS,A$2ØØØ
LOCK FILER
```

**"addr" depends on the release date of FILER. Here are the values of "addr" for two different release dates:

Release date	addr
1 JAN 84	4244
18 JUN 84	426A

Page A-34:

In the listing of the "TYPE" program, change the value 4 to 5 in line 2Ø7 as follows:

```
2115:CØ Ø5          2Ø7             CPY   #5
```

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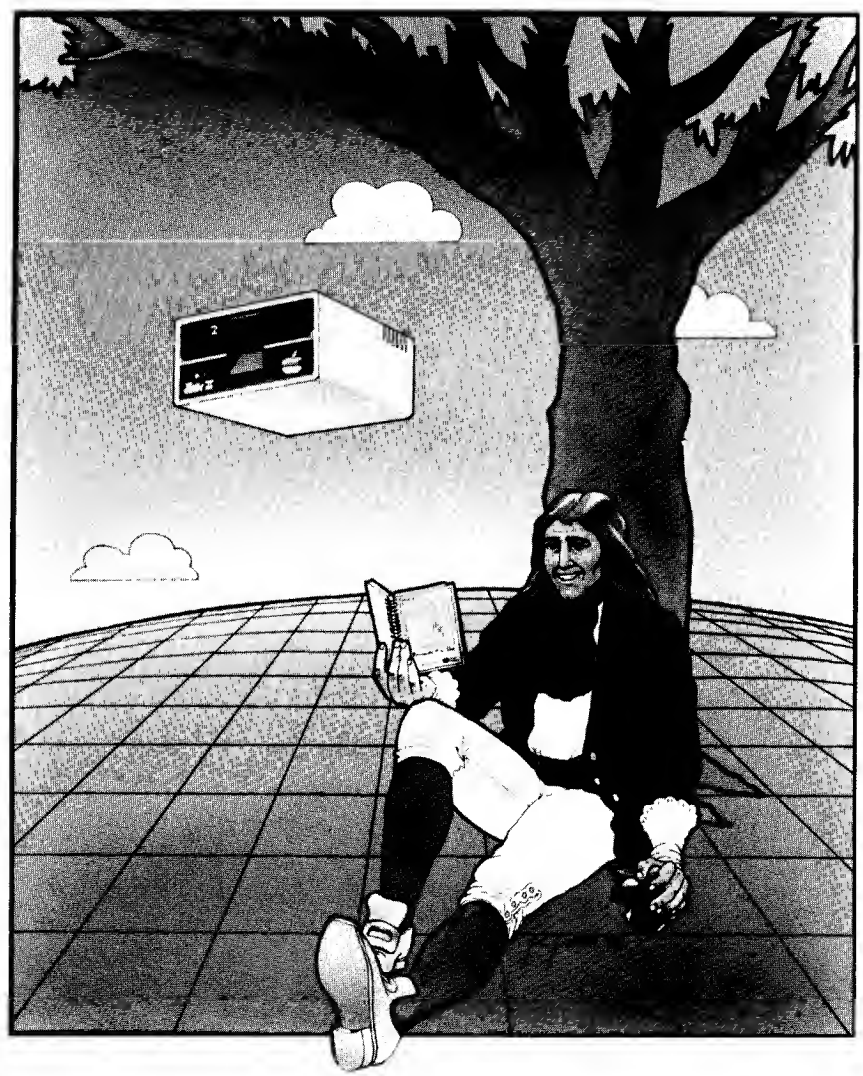
City, State, Postal Code _____

Country _____

SUPPLEMENT TO

Beneath Apple ProDOS

For ProDOS 8, Versions 1.2 and 1.3



by Don Worth and Pieter Lechner

QS QUALITY SOFTWARE